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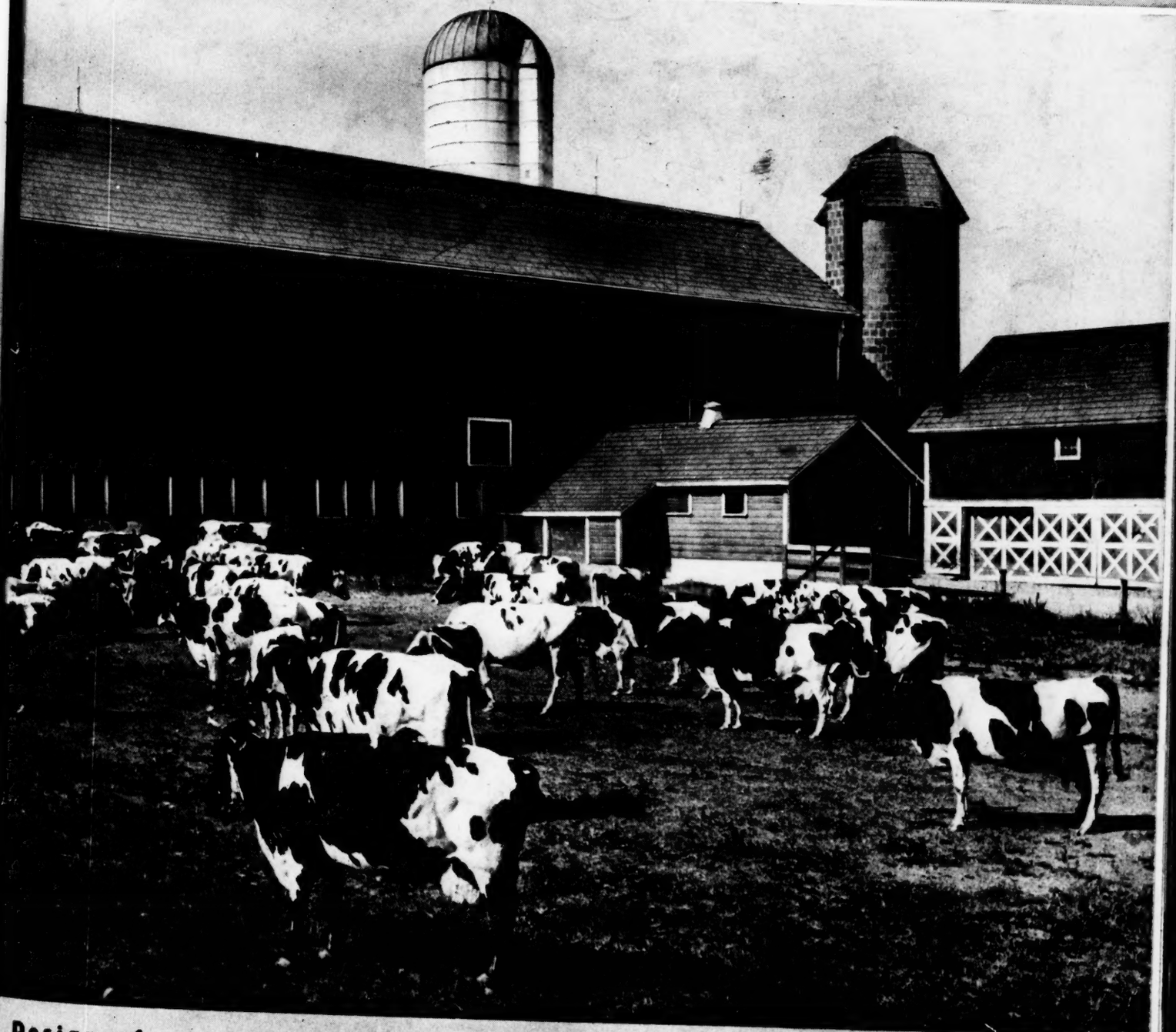

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A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, AIR SANITATION, PIPING, HEATING AND VENTILATION

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THIS MONTH'S COVER

The engineer must view the cow as a heating and air conditioning plant in the design of dairy stables. See an engineer's analysis beginning page 81.

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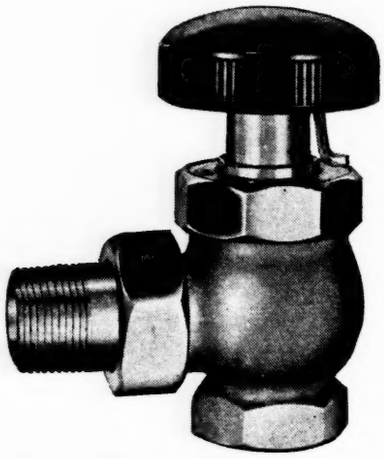

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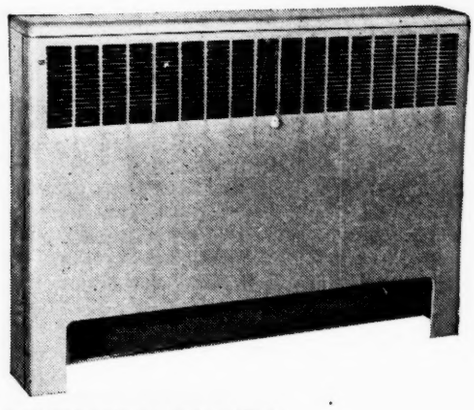

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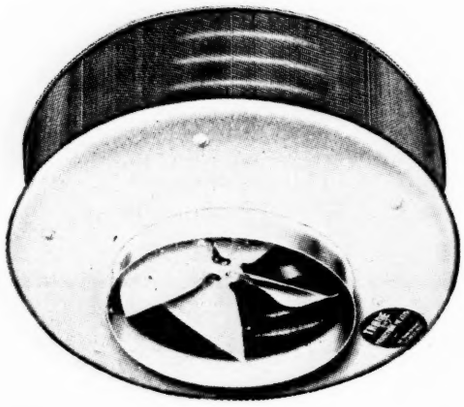

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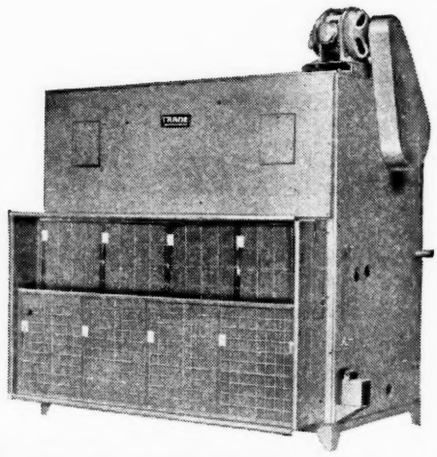

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Washington News

LORING F. OVERMAN

Priorities for building.
Veterans favored.
Building estimates affected.
What about building codes?
National code base advanced.

NOT since the beginning of the war have the heating, ventilating and air-conditioning industries been confronted with a government regulation involving more question marks than does Priorities Regulation 33.

To become effective January 15, the new regulation will:

(1) Establish special priorities to assist builders who will give preference to veterans in selling or renting new low-cost housing;

(2) Set aside to honor such priorities approximately 50% of the 10 most critical building materials;

(3) Limit virtually all home construction during 1946 to units costing less than $10,000, including land; and

(4) Curtail commercial, industrial and multi-unit construction to some extent by assigning to low-cost housing a greater percentage of available materials than normally flows into this field.

Question Marks

It is impossible at this time to forecast just how PR33 will affect the planners, producers and installers of major units of heating, ventilating and air-conditioning equipment, but it would be short-sighted to conclude that a nationwide movement to channel building materials into the small-homes market will not have certain definite results—possibly negative. On the other hand, it is probable that all of the units the industries will be able to produce and install under present labor-supply conditions will find a market in the no-priority section of the building field.

Thus only time will tell whether PR33 must be viewed as threatening to curtail the heating, ventilating and air-conditioning market during 1946, or whether its enactment will give these industries a breathing space in which to catch up on back orders.

Veteran No. 1 Purchaser

In any event the new regulation, while not expected to solve the stated demand for 3,000,000 homes for returning servicemen and their families, places the veteran in the position of preferred purchaser. It also defers, for the duration of the regulation, most of the new-home hopes of non-service purchasers. While the regulation does not actually prevent the construction of homes costing more than $10,000, materials for higher priced construction is to be available only after materials earmarked for veterans have been delivered. Too, it is anticipated that virtually all skilled construction labor will be absorbed by the veterans' home-building program, leaving little available for work in non-priority fields.

The Civilian Production Administration, which issued the new regulation, has delegated to the National Housing Agency the power to award priority ratings through its 52 field offices. The ratings will be assigned either to the individual veterans who wish to build for themselves, or to builders who wish to erect one or more dwellings, in the sale or rental of which preference will be given to veterans of World War II.

Regulation Explained

The following points in connection with the new regulation were outlined by CPA officials:

(1) An applicant for the HH rating must give, in general, specifications of what he plans to build under the reconversion housing program and the price or rental at which he will make it available to veterans. The Federal Housing Administration must be satisfied that the proposed price or rent is reasonably related to the proposed accommodations;

(2) Applicants must show to the appropriate FHA field office that they will be ready to start construction within 60 days. Applicants must demonstrate that they have effective control of the land, that financing is assured, and that arrangements have been made for local building permits, utility services and the like. If construction has not been started within 60 days the rating becomes void and a new application must be filed;

(3) An applicant must agree to make the housing available only to veterans during the period of construction and for 30 days thereafter, at the conclusion of which period he may sell or rent to non-veterans, but on the same terms which he had agreed to make the housing available to veterans;

(4) In his sales agreement a veteran or other purchaser is pledged to the same 30-day waiting period exclusively for another veteran, and in the case of a resale, the price must be no higher than that originally paid;

(5) The regulation has also been written to provide for conversion of existing construction if such conversion will result in increased housing facilities; and

(6) The regulation was written to provide not only moderate priced houses and multiple-unit dwellings, but also dormitories or group housing for educational institutions serving veterans.

Building Estimates Affected

It is anticipated in Washington that the new program will have important but currently unpredictable effects upon over-all building estimates for the year. Only a few days prior to issuance of PR33, the Construction Division, Bureau of Foreign and Domestic Commerce, had estimated 1946 new construction at $7,300,000,000 and repair and maintenance at $5,000,000,000. According to William H. Shaw, chief of the Construction Statistics Unit of the division, construction in 1946 should be 60% better than in 1945. Mr. Shaw's only proviso at the time he issued the figures were that manufacturers, dealers, builders, management and labor must work together to keep costs down.

A striking feature of the 1946 estimate, Mr. Shaw pointed out, was that almost three-fourths of the total for new construction—$5,200,000,000—would be privately financed. This is a complete reversal of experience during the last few years and represents a figure not duplicated since 1929.

The goal of the new program is 400,000 new homes for veterans. The building industry has already estimated it cannot produce much more than 450,000 homes in 1946, leaving relatively few for non-service buyers. Too, there are indications that the goal for service men might be extended, further curtailing any non-service surplus that might develop.

Effect of the program on industrial and commercial building can be gauged by the fact that home construction normally gets only 35% of the building materials, while it will be assigned 50% under the priorities system. Veterans' hospitals have an additional priorities program of their own, and communities will be urged to use their building permit system to channel materials into worthy projects.

Old Reliable Red Band Says—

"An ancient Greek called the turn"

When an ancient Greek philosopher once predicted that "Human slavery will continue until the loom weaves of itself," he really called the turn of important events to come. Events destined to free men from slavery . . . cut the costs of goods . . . raise the standard of living—

In early colonial days in our country, our forefathers were still spinning and weaving by hand, as the early Greeks did, to make clothing for the family. The driving force that was to mark another important milestone in man's progress, was still to be discovered—

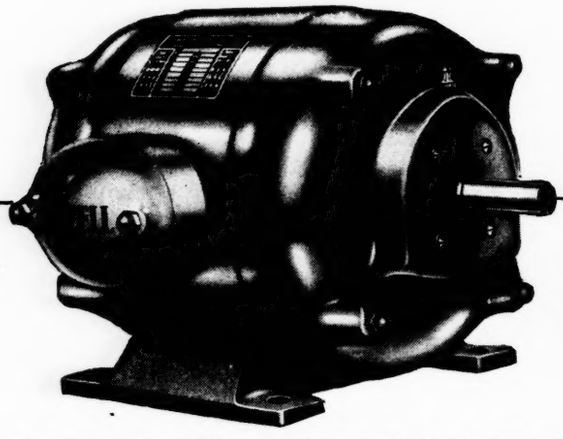
Today, not only the loom but machines, which make products numbering into thousands, turn by themselves with electrical horsepower. Howell—a specialist in industrial type motors for more than 30 years—builds motors for many of these machines from ¼ to 150 h.p.

Have you a hard job for Horsepower?

Years of specializing in making industrial type electric motors to meet the exacting requirements of the automotive, machine tool, dairy, food and other important industries, have enabled us to make Howell Motors better than ever.

Today, as always, Howell Motors are quality-motors. They are smooth-operating and quiet, too, because they are statically and dynamically balanced. They are better performing because they are built of the finest materials—copper or bronze rotors—and completely insulated. They are trouble-free on the job because they are designed for the toughest tasks in industry—consequently, they perform better on all jobs.

For your needs, in specialized or standard motors, from ¼ to 150 h.p., phone the nearest Howell Representative. Remember, you pay no more for industrial type Howell Motors . . . but you always get top quality for your money.



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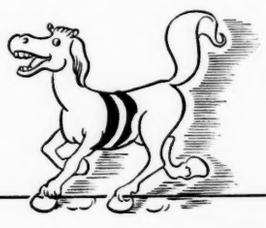

HOWELL MOTORS

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Housing Czar Named

Indicative of the importance attached to housing by official Washington circles is the appointment of Wilson W. Wyatt, Louisville, Ky., as Housing Expediter, Office of War Mobilization and Reconversion. Mr. Wyatt's presence in Washington indicates that official planners expect the housing problem to become increasingly difficult as increasing numbers of returned veterans put on the pressure to "have something done" about the situation. There are some in Washington who believe that PR33 is only the beginning of a series of drastic regulations which may eventually make the restrictions of wartime Order L-41 look like pikers. That efforts will be made to stop all building except that of homes is predicted, but it is expected that someone will insist that the commercial and industrial machine must be kept in order if the needed homes are to be more than just empty shells.

Next Problem, Building Codes

With so much stress being placed upon the construction problem, the multiplicity of conflicting building codes in effect throughout the country will doubtless come in for another round of cussing and discussing. Under the guise of wartime necessity there was a tendency to waive some of the more stringent requirements between Pearl Harbor and V-J Day, but inspectors in some 2,000 communities having building codes of their own are beginning to shine up their spectacles and start looking for violations.

Among those recommending a set of national building standards, with a certain amount of leeway to adapt them to local conditions, is George N. Thompson, Chief, Division of Codes and Specifications, National Bureau of Standards, Washington, D. C.

"At a time when all possible ways of assisting the construction industry to provide adequate housing and other structures are being examined," said Mr. Thompson, "it is natural that building codes should come in for their share of criticism." Much current criticism is quite general in nature, but analysis discloses several features that are causing concern.

"One complaint is that codes continually fall behind progress in the construction art. Related to this is the charge that they do not make suitable provision for the prompt recognition of new materials and methods of construction. Another is that unnecessary amounts of material are required, causing excessive costs."

Some Criticism Justified

Mr. Thompson observes that no very extensive study of codes is needed to demonstrate that in some respects they do not keep up with latest standards embodying generally approved methods of construction. One reason, he explains, is that codes are customarily revised only at considerable intervals of time because of the bother and expense of overhauling.

Another reason is that there are legal objections to adopting latest editions of standards by reference without specifying a definite edition. When the edition is identified by date, this reference stays in the code for some years during which the standard itself may have been revised several times. The remedy lies either in systematic and frequent overhauling of the code or development of a legal method for automatic use of latest standards as issued.

"With regard to treatment of new materials and new methods of construction," said Mr. Thompson, "there is much misunderstanding of code provisions. Actually, many codes do prescribe means for dealing with such innovations. They do this in general terms since it is impossible to foresee just what is over the horizon. The method employed calls for acceptance on proof, through test and other evidence, that the material or construction is safe for the intended purpose. The trouble here is that standard methods of testing are lacking in some cases and so the basis for acceptance is not developed to the extent that it should be. The remedy here is to develop such standard tests.

Local Conditions Important

"Recommended requirements developed on a national basis, using the best methods that can be developed, can be a powerful influence in correcting inadequate or excessive regulations, but there is always some necessity for adjustment to local conditions. The wind blows harder in some localities than in others; the possibilities of a severe earthquake vary, and the kinds of materials available may differ.

"From what has been said, it would appear that a fundamental step to be taken in any program of building-code improvement is to establish a reference base of universally acceptable requirements with which any particular code can be compared. If such comparison shows marked divergence from the standard, it may be that this is due to differences in local conditions, in which case criticism may possibly prove unwarranted. If there is no apparent necessity for the difference, then the reason may be that the individual code has not caught up with the latest thought on the subject or there may be other reasons which do not prove on analysis to be justified. An approach in this manner has the merit of proceeding in logical sequence and is more convincing than general criticism unsupported by evidence."

Progress Reported

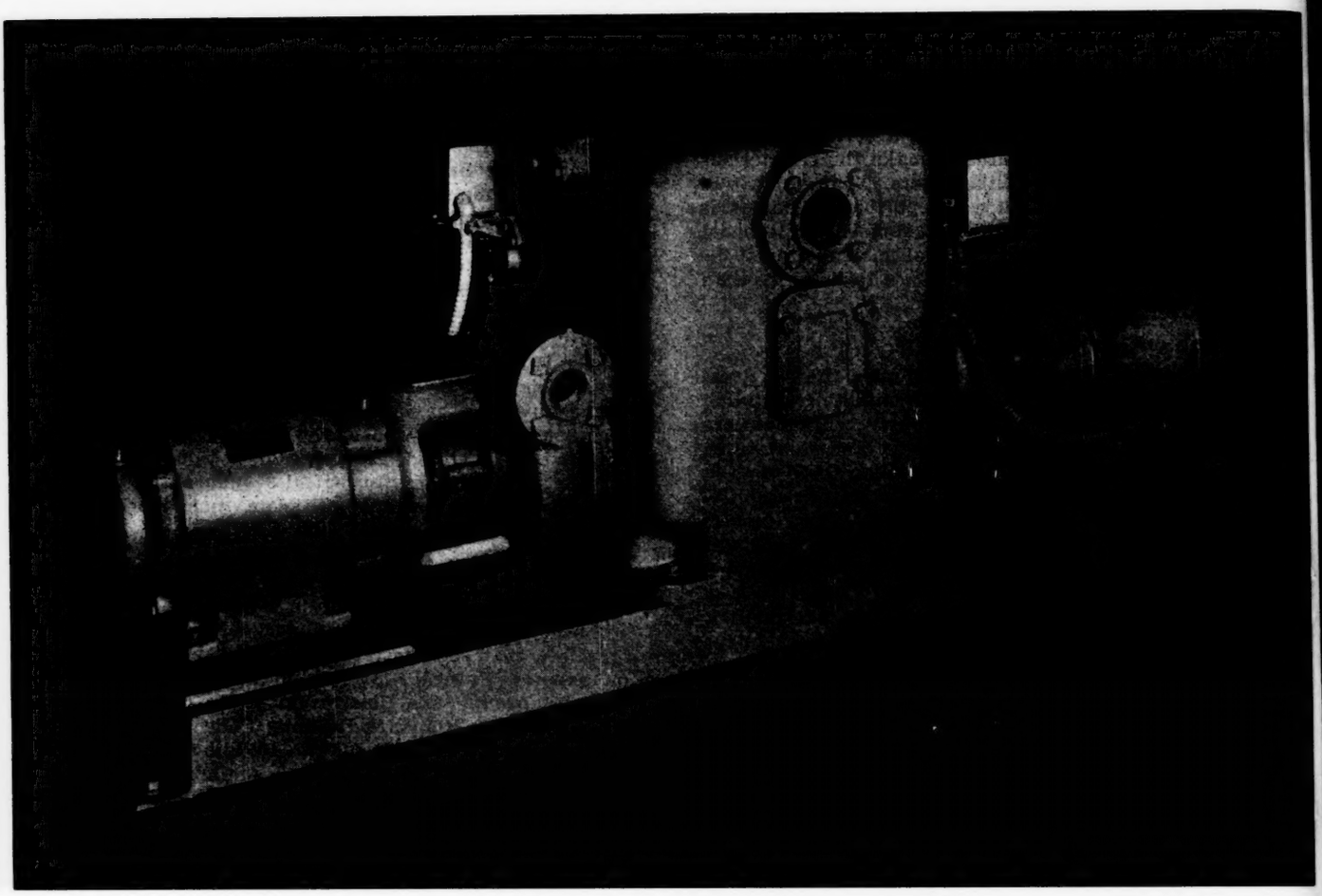
Good progress is being made in establishing the reference base through cooperative work of representatives of professional societies, building officials, fire protection experts, Federal Government agencies and other interested groups. An illustration is the recently completed American Standard Building Code Requirements for Minimum Design Loads in Buildings and Other Structures, which will soon be available from the Government Printing Office as Publication M179 of the National Bureau of Standards. In this are presented recommendations for assumed loads caused by materials used in building construction, by occupants and furniture, by wind pressures and by earthquake forces.

Another publication recently issued is American Standard Building Requirements for Masonry. The National Bureau of Standards acted as sponsor for the work on these projects under the procedure of the American Standards Association. Standards approved by other sponsoring organizations have been issued dealing with structural steel, reinforced concrete, and code administration, while still others are in process of development, with some nearing completion.

"The building industry is often pictured as a loosely knit group of organizations whose interests are somewhat divergent," said Mr. Thompson. "With respect to that portion of its general problem represented by imperfect building-code requirements, however, representatives of the organizations concerned have shown a capacity to meet and produce constructive results through application of good will and common sense. While views may differ on what constitutes reasonable building-code requirements, the important thing is that the need for cooperative action is recognized and arrangements are in effect to proceed with a program that should command respect. Such a program can make a very definite contribution toward safety and economy in the construction field.

"Finally, it should be recalled that building codes are very largely in the form of municipal ordinances. Any recommendations that may be developed as to their contents must find their way through voluntary acceptance into local legislation in some two thousand cities and towns. This is not likely to be accomplished overnight. But the increased interest shown in good requirements indicates that the work being done in this field will be reflected in many local codes that are being examined in anticipation of postwar construction activity."

MAXIMUM EFFICIENCY FOR STEAM HEATING SYSTEMS ON HEATING, DRYING AND PROCESS WORK.



JENNINGS CONDENSATION PUMPS

Designed for steam systems on heating, drying, or process work, these pumps offer the most reliable and efficient means of returning hot condensate to boiler or hot well. In many cases these pumps will save costly installation of boilers in a pit to provide gravity flow of returns from basement radiators and heating devices.

The Jennings Condensation Pumps are sturdy and compact in construction, and combine receiving tank, pump and driving motor in a single assembly. Pumps are bronze fitted throughout, with tobin bronze shaft. The pumping impeller is of special design, made possible by our wide experience with return line heating pumps, and is especially adapted for handling hot water with the greatest possible efficiency.

Full automatic control is furnished by means of a ball float and float switch mechanism mounted on the receiving tank. All wiring is made up at the factory, and it is necessary only to connect the pump to the system and hook up the leads. Complete information regarding these economical pumps sent promptly on request.

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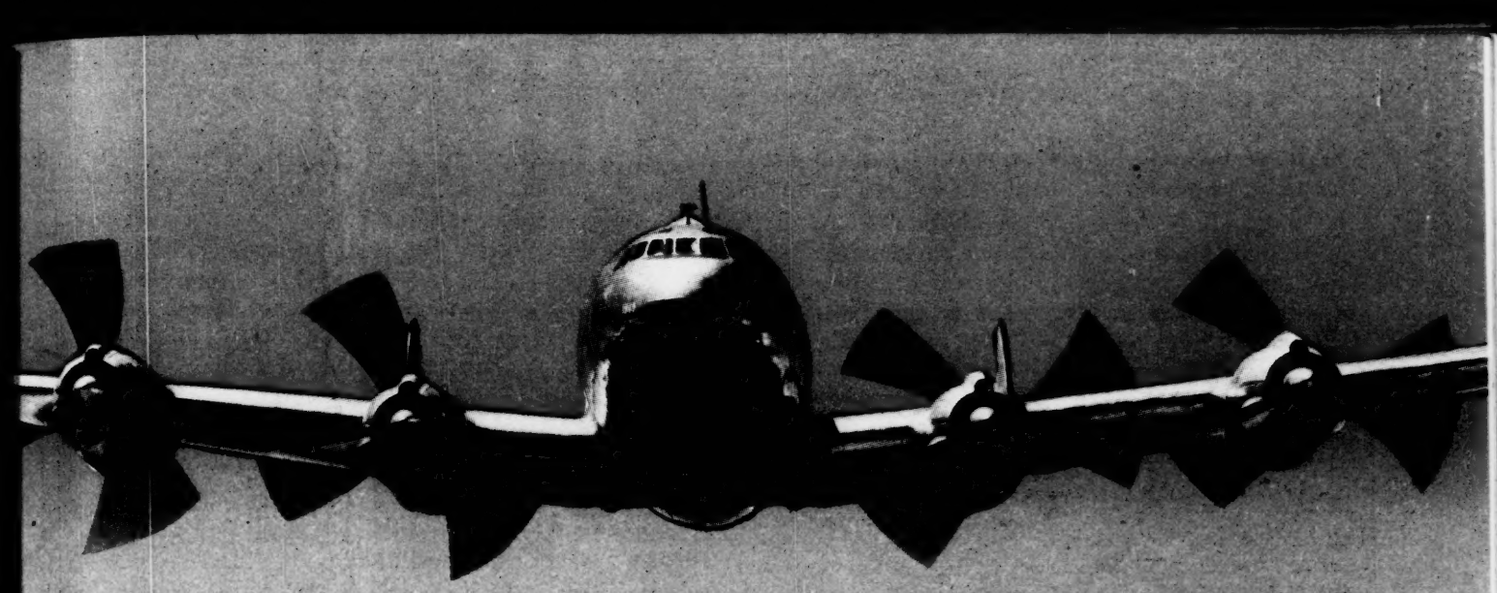


Refrigeration for Air Conditioning Pressurized Transport Aircraft

BERNARD L. MESSINGER

Group Engineer, Thermodynamics
Lockheed Aircraft Corp.
Burbank, Calif.

It is the primary purpose of this abstract of a paper originally presented at the National Air Transport meeting of the Society of Automotive Engineers to explain the selection of the air cycle as the most practical type of refrigeration for application to pressurized transport aircraft. The use of the Constellation airplane for the purpose of illustrating the application of these methods is incidental. In the opinion of the author the conclusions are applicable to all pressurized transport aircraft of comparable size and similar service.

THE Lockheed Constellation was among the first transport aircraft to include refrigeration equipment as part of its air conditioning system. This system, which was conceived as part of the initial airplane design in 1939, also pioneered the application to aircraft of such features as the recirculation fan and heated cabin wall panels.

The original refrigeration equipment was of the vapor compression type and its development was interrupted by the United States' entry into the war.

Early in 1945 design was revised to conform to its original purpose as a commercial airline transport. All of the original air-conditioning features as well as several new ones have been incorporated into an entirely new system.

A design analysis of the entire air conditioning system is beyond the scope of the present paper, but it was felt that a study of the refrigeration function would be of particular interest since it is an entirely new problem and involves the use of equipment which has been developed expressly for this application.

During the development of refrigeration equipment, it became apparent that an air-cycle refrigeration system could be designed for a very small expenditure of weight and space. The new air-conditioning system, therefore, will employ an air-expansion-turbine unit in place of the vapor-compression unit which was included in the original version of the airplane.

The aircraft industry has just recently reached that stage in its development where the subject of passenger comfort is receiving a degree of attention that is comparable to that which was formerly devoted entirely to the external performance of the airplane.

Just to briefly review the various factors related to passenger comfort, the following items are listed:

(a) Temperature
(b) Pressure (or cabin altitude)
(c) Rate of pressure change (or rate of climb and descent)
(d) Noise
(e) Vibration
(f) Air movement (or distribution)
(g) Ventilation (or oxygen supply)
(h) Humidity
(i) Odor, dust and smoke
(j) Airplane attitude (angle and "bumpiness")
(k) Fixed equipment (seats, berths, lounges, lighting, etc.)

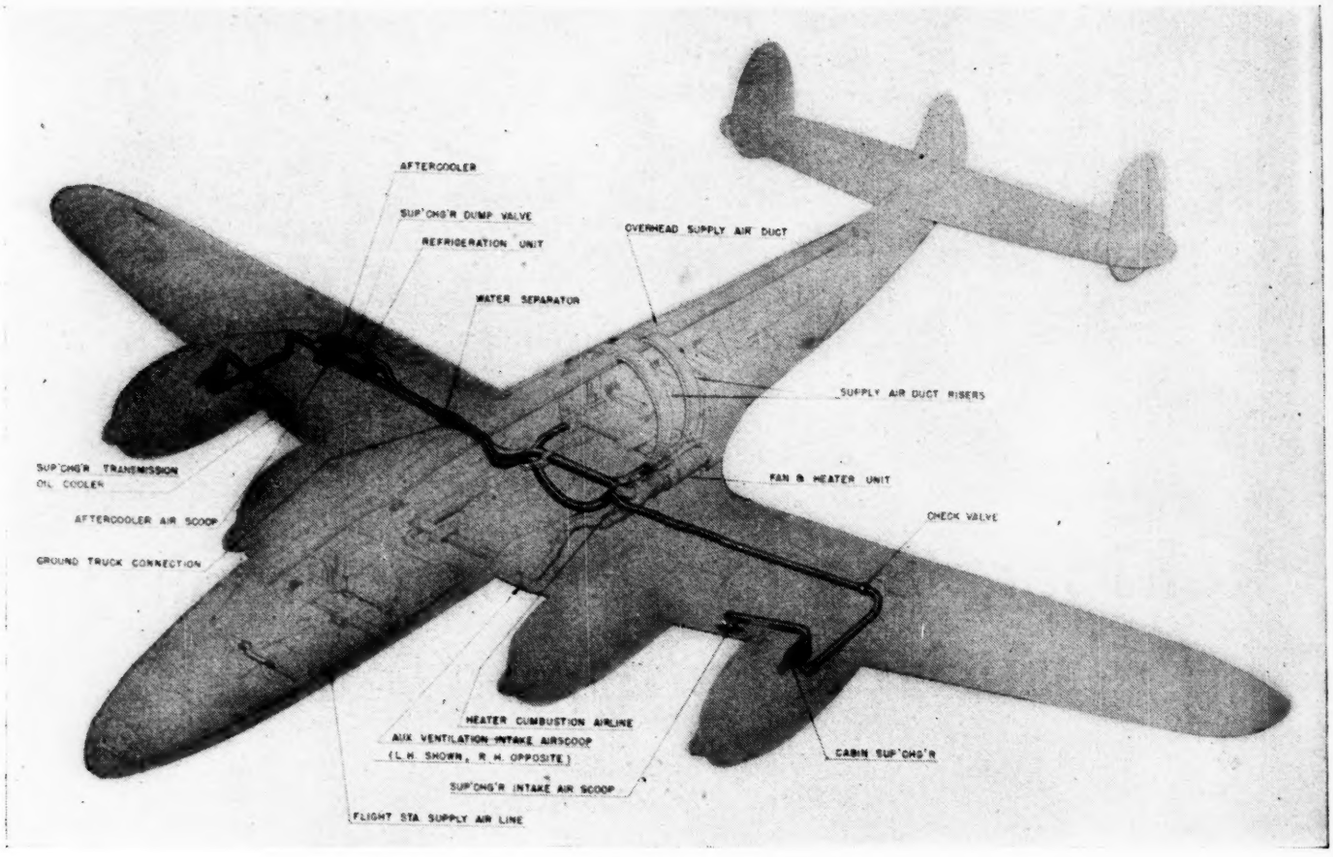


Fig. 1. Phantom sketch of Constellation air cycle cooling installation.

If the cabin pressurization equipment is considered a part of the air-conditioning system, it can be seen that the latter exerts control over all of the comfort factors except (d), (e), (j), and (k).

It is thus apparent that the overall control of passenger comfort depends on a variety of factors. Refrigeration, the subject of this paper, influences only two of these, namely, temperature and humidity, and yet without adequate control of these two, the significance of the remaining items is greatly diminished.

Need for Refrigeration

It is a common misconception among many engineers that aircraft air-conditioning does not require refrigeration simply because airplanes can be flown at a sufficiently high altitude to avoid excessive ambient temperatures. That this is only approximately true for unpressurized aircraft and not at all the case for pressurized transports can be rather easily demonstrated.

The principal fault in the above concept is that on a design summer day, based for example on the Army maximum temperature-altitude relationship, a 75F ambient temperature is not attained until the airplane has reached an altitude of 7,000 ft. The existence of a 75F ambient *static* temperature does not mean that the cabin can be maintained at 75F without the removal of heat. There are two principal reasons for this. First, there are numerous internal sources of heat in the cabin; among these are the occupants, the solar radiation through transparent surfaces, the various electrical devices such as radio equipment, inverters, motors, lights, and a slight effect due to thermal lag. The second reason has to do with the difference between static and total temperature, or stated another way the temperature rise due to stopping (relative to the airplane) air having an initial velocity equal to that of the free stream. For the older type of transport which has a climb speed of 110 to 120 mph, this latter factor amounts to only 2F, but for present day aircraft it may amount to 5 or 6F during climb. In level flight it can become 15 or 20F. As an interesting side-light it might be well to point out that in recent high speed military fighters this temperature rise reaches 50F in level flight. It should be noted that this effect is present not only in the air that is stopped while being brought into the airplane but also in the boundary layer which envelops the entire external surface. The net practical effect is equivalent to placing the airplane in an atmosphere at a temperature very nearly equal to the total temperature.

Due to the above factors it is generally not possible to maintain the cabin temperature within less

Constellation Statistics

4 motors
10,000 horsepower
64 passengers
350 miles per hr. cruising speed
New York to Paris in slightly more than 14 hours
Can land at 80 miles per hr. on any standard airport
At top gross weight of 100,000 lb. can take off with 2,000 ft run.

than 10F to 20F of ambient static temperature, even though adequate (one complete air change per minute) ventilation flow rates are provided. Thus at 7,000 ft altitude on a summer day the cabin temperature would range between 85F and 95F. Obviously at altitudes below 7,000 ft even higher cabin temperatures result. The relationship is not linear, however, because the sensible heat liberated by the occupants diminishes as the cabin temperature approaches body temperature, 98.6F.

Although of minor significance, it should be noted that thermal insulation in the fuselage wall is a disadvantage in any such condition in which the cabin temperature is above ambient temperature since it limits the amount of heat which can flow outward.

One very significant aspect of the airline operator's problem involves the elapsed time between the terminal and the point of take-off as well as the corresponding ground maneuvering time after landing. This time element is quite variable. For a two-engined transport the minimum time for taxiing and engine run-up has been estimated at 5 minutes and the average at about 8 to 10 minutes. For a four-engined airplane the average time would probably range between 10 and 15 minutes. For large airports operating with a heavy flow of traffic the time required to obtain clearance from the control tower has on some occasions resulted in causing airplanes to stay on the ground for as much as 30 minutes after leaving the terminal. From the standpoint of the psychological effect on the passenger, particularly a new airline customer, the conditions which prevail in the cabin at the beginning and end of a flight are of primary importance.

The foregoing discussion which applies only to unpressurized aircraft indicates the fallacy in the contention that refrigeration is unnecessary. In the case of airplanes in which pressurization begins at take-off, all of the above considerations are applicable in addition to those contributed by the process of supercharging the cabin. The effect of the latter is due to two factors, (1) the elimination of the large ventilation flow rates as a result of the practical limitations of the superchargers and (2) the fact that even when aftercoolers of high effectiveness are used, the air enters the cabin at a temperature somewhat higher than the ambient total temperature.

In a flight at moderate altitude the temperature conditions in flight are almost as severe as those on the ground. Pressurized flight without refrigeration would obviously be intolerable and flight with maximum ventilation would be little better. For this type of operation the use of refrigeration contributes a very significant degree of comfort.

On a non-stop trans-continental operation, a large proportion of the total elapsed time is at an altitude at which cooling by refrigeration is ordinarily not required. On an Army summer day, however, even at 20,000 ft some cooling is required in order to bring the cabin temperature from 86F down to 75F. Unpressurized commercial operation is possible only below 12,000 ft and preferably below 8,000 ft. If the climb is made in the unpressurized condition, the cabin rate of climb is equal to that of the airplane and may cause passenger discomfort unless the airplane flight plan is governed to avoid the latter.

During the ground maneuvering period of both flight plans the only alternative to refrigeration which has been indicated, is the use of the cabin fans as a means of ventilation. It would be entirely impractical to introduce supercharged air into the cabin in the absence of refrigeration while on the ground since the low effectiveness of the aftercoolers during this period would result in a cabin temperature of at least 130F.

Design Conditions

The design conditions for the Constellation were established after the manufacturer and the airline operators had jointly reviewed the significant operating requirements which would be met in service.

The resulting requirements which have been used are:

(1) The airplane refrigeration system is to be capable of delivering the required capacity in flight or on the ground as long as both outboard engines are operating at 1200 rpm or more.

(2) A ground truck or its equivalent is considered acceptable for refrigeration of the airplane while it is parked without engines running. The truck is to be as simple and free of service problems as possible.

(3) The refrigeration equipment is to be quickly removable as a unit so that during winter operation

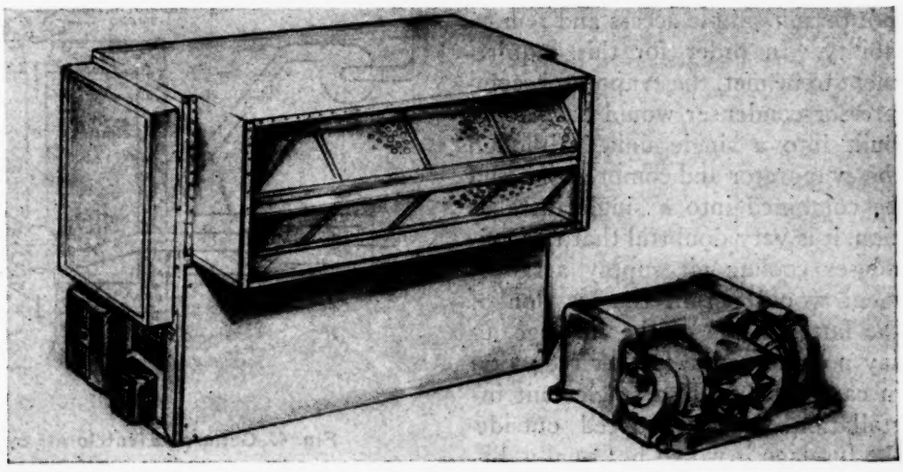


Fig. 2. A midget by comparison, the tiny air expansion turbine (right) designed to cool the Constellation cabin has more cooling capacity than a 5,000 lb cooler (left) such as is used in Pullman cars.

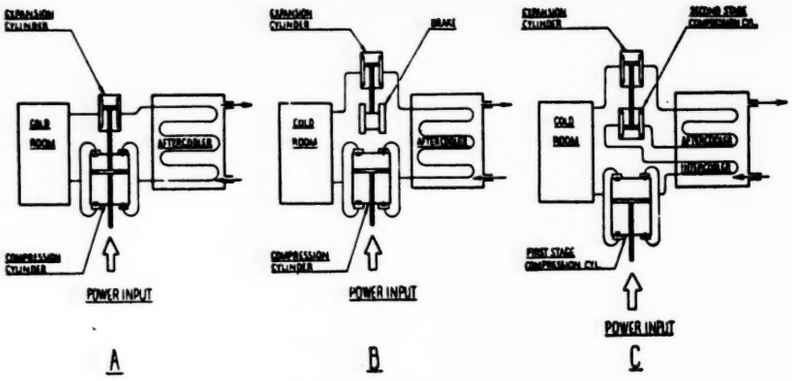


Fig. 3. The air refrigeration cycle showing "bootstrap" and "non-bootstrap" methods of dissipating heat of work done in expansion.

a negligible weight penalty will be charged to this system. This provision also permits easy access to the equipment for maintenance purposes.

(4) The design ambient temperature is to correspond to the "Army Summer" day plus the adiabatic rise.

(5) An absolute humidity of 109 grains per pound of dry air is the design value at sea level. This corresponds to a relative humidity of 38% which was considered constant for all altitudes up to 20,000 ft.

(6) The minimum design cabin dry bulb temperature is to be 75F and the cabin absolute humidity.78 grains per pound of dry air or 60% relative humidity.

(7) The design calculations are based on carrying 60 occupants although the normal number for the commercial version of the airplane is 54 including a crew of 6. One alternate arrangement provides for 64 passengers.

(8) The minimum supply of outside air is to be 50 pounds of air per minute which is based on a consideration of the odor and smoke control problems.

Vapor Cycle

In terms of the energy consumed per unit of refrigerating effect, the vapor-compression cycle is by far the most efficient. It was because of this well known fact that Lockheed's initial refrigeration development program was directed toward this type of equipment.

However, this installation does not permit simple access and removability. In order for this requirement to be met, the evaporator, compressor condenser would have to be built into a single unit. Although the evaporator and compressor could be combined into a single installation, it is very doubtful that the condenser cooling air supply arrangement would permit the location of the latter inside of the fuselage, to say nothing of the further reduction in cargo space. If a single unit installation were attempted outside the fuselage it would be equally difficult to bring all of the recirculated air from within the fuselage to a single evaporator located outside and then return the air to the inside once more. The total of the individual estimated weight components is 585 lb or 58.5 lb per ton of capacity.

Dry Ice System

The simplest form of this type of system would consist of a means for circulating cabin air over slabs of the frozen material. There are unfortunately several reasons why this arrangement would not be acceptable for use in this application. These are:

(1) The surface area of the ice progressively diminishes during the melting process and thus reduces the heat transfer capacity.

(2) Due to the low surface temperature, the condensation of moisture is greater than necessary. In the case of dry ice the very low surface temperature causes the formation of an insulating blanket of frost, thus reducing the rate of heat transfer.

(3) The use of dry ice, which has almost twice the refrigerating effect of water ice per unit weight,

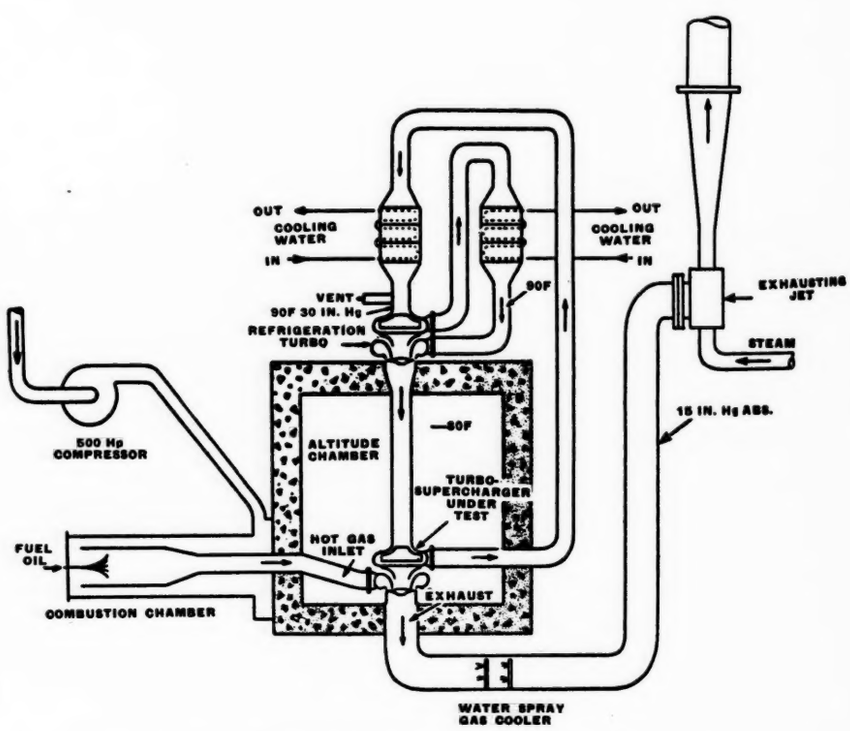


Fig. 4. General Electric air cycle refrigeration for testing turbo-superchargers.

involves the liberation of a prohibitive volume of CO_2 gas during pressurized operation.

The sum of the approximate weights is 458 lb exclusive of the dry ice itself which would weigh 450 lb. Thus the initial total weight for the Los Angeles to New York flight would be 1308 lb or about 131 lb per ton. The total weight after half the total elapsed time would be about 883 lb or an average unit weight of 88 lb per ton.

Air Expansion Turbine System

The air refrigeration cycle, which has been selected as most practical for the Constellation, found fairly widespread application during the early days of mechanical refrigeration. Today it is practically extinct in the commercial field. Its disappearance is due to the high degree of development experienced by the more efficient vapor cycle. It is significant that the peculiarities of the airplane are such that a system of refrigeration which has been superseded in every other field of application proves to be the most practical of all in this particular field.

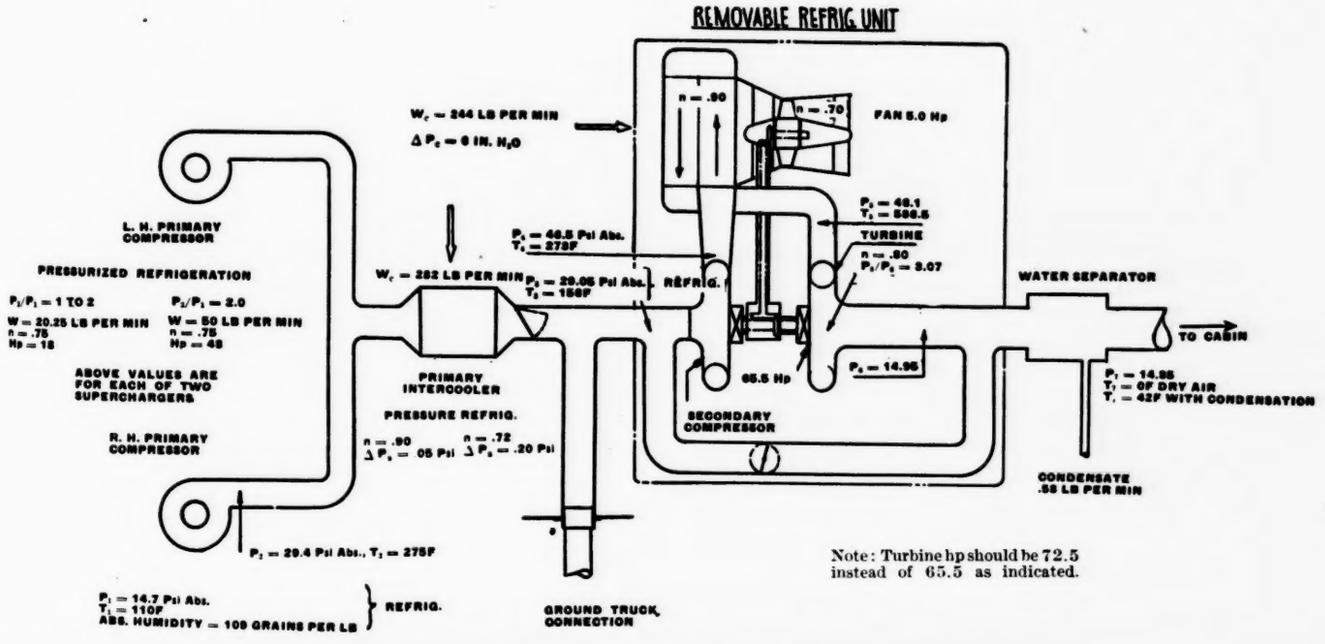
Fig. 3-A, which is taken from Goodenough, is typical of similar illustrations to be found in any standard thermodynamics textbook. In this arrangement, known as the open-type air cycle, external power is applied to the compression cylinder which draws air from the cold room at atmospheric pressure and discharges it into an aftercooler which removes the heat of compression. The air then passes through the expansion cylinder which returns the work of expansion to the compression cylinder to thus augment the external power supplied. The heat equivalent of the work done in the expansion cylinder is in this way removed from the air which then enters the cold room at a low enough temperature to produce the required refrigerating effect.

Note that the same amount of cooling could be obtained by dissipating the work of expansion in a friction brake and supplying the work of compression entirely from the external source of power. This is illustrated in Fig. 3-B, and indicates the distinction between a regenerative system, or, in recent military parlance, between a "bootstrap" and a "non-bootstrap" system.

Fig. 3-C shows an arrangement which is functionally equivalent to that of Fig. 3-A. In this case, however, the compression process has been divided into two stages, the first of which obtains all of its power from the external source, and the second entirely from the expansion cylinder. Note that intercooling between stages is available in addition to the final aftercooling. Except for the fact that new air, rather than recirculated air, is introduced into the compressor, the Constellation system is basically equivalent to this last arrangement.

The first application of turbo machinery to the air cycle, that the author is aware of, is described in General Electric's 1943 Supercharger Symposium Lecture Book from which Fig. 4 has been taken. In this case it is used by the General Electric Company as a convenient method of obtaining air at a very low temperature for testing turbo-superchargers under high altitude conditions. When it is realized that a device having the size of a standard aircraft engine turbo-supercharger has a refrigeration capacity of about 100 tons when used as shown in Fig. 4, it is apparent why this method becomes such an attractive solution for the airplane cooling problem.

After Lockheed had reached its decision to install an air turbine system in the Constellation, it was also decided to attempt to procure the necessary equipment from an outside vendor if possible. As the initial step in this program a diagram practically indentical to Fig. 5 was submitted to the Airesearch Manufacturing Company of Inglewood, California, who showed significant interest in a program to develop suitable equipment for this application. Considerable credit is due the management and engineering department of this company for their progressive attitude in this cooperative effort.



Note: Turbine hp should be 72.5 instead of 65.5 as indicated.

Fig. 5. Basic schematic diagram of aircraft air cycle refrigeration system.

Fig. 5 illustrates the functional arrangement of the airplane system. The similarity to Fig. 3-C is evident. All of the refrigeration equipment is contained in a single removable unit which requires no external connections other than those at the air inlet and outlet. No power is supplied to the unit by mechanical or electrical means. Power enters the system only through the cabin superchargers. These superchargers are no larger in capacity than if designed for pressurization alone. This is due to the fact that they are designed for high altitude inlet air density and when operated at maximum speed at sea level they have the inherent capacity to supply the increased mass-flow required for maximum refrigeration. Obviously there is an increase in the power required under this condition at sea level and the transmission design is based on this maximum requirement. All of the significant design quantities are shown in Fig. 5.

In order to meet the airline requirement to be able to cool the airplane on the ground in the absence of ram, the author suggested the solution illustrated in Fig. 5, namely, the application of the turbine power to both the secondary compressor and the coolant air fan. Prior to this solution it was common practice to either deliver the entire turbine power to the secondary compressor and depend only on ram air for cooling the aftercooler, or to wastefully deliver all the turbine power to an inefficient fan for supplying aftercooler coolant air, the latter fan acting more as an energy absorber than as a fan. That this second method is very inefficient is apparent when the fan power and turbine power shown in Fig. 5 are compared. Because power is not fed "upstream" to a secondary compressor this method has been referred to as the "non-bootstrap" system.

The water separator shown serves to remove about sixty percent of the entrained free moisture which, under design conditions, is condensed at the turbine. The remaining forty percent will be evaporated during the process of mixing turbine air with recirculated cabin air, thereby making this latent cooling capacity available as sensible cooling in the cabin. Control is accomplished by means of a simple bypass valve as indicated.

The air enters the airplane through two flush scoops on the lower surface of each wing leading edge and is delivered to the primary centrifugal compressors which are located in the outboard nacelles. These are driven from the main engines through variable speed transmissions which permit the full refrigeration capacity to be obtained at engine speeds down to 1200 RPM. Although the transmission is not of the slip-pump type a small oil cooler is required and is in the leading edge just inboard of each outer nacelle.

The discharge air from both compressors is ducted to a single primary intercooler located in the trailing edge section of the right hand wing. The removable refrigeration unit is located adjacent to the intercooler. From this point an insulated duct takes the cooled air through the water separator and then into the cabin distribution system.

By separating the compressor and the turbine to permit locating the coolant fan between them, Aireseach engineers were able to greatly simplify the problem of driving the fan. A single right angle reduction gear transmits power from the turbine-compressor shaft to that of the fan. The heat exchange is a two pass semi-counter flow type of tubular construction. Coolant air is drawn through this aftercooler from a flush opening in the lower surface of the wing and then discharged horizontally aft from the fan through an opening in the trailing edge structure. The unit is shock mounted at the four lower corners and is quickly removable through the lower surface of the wing. A suitable section of duct will be provided to replace the unit during winter operation.

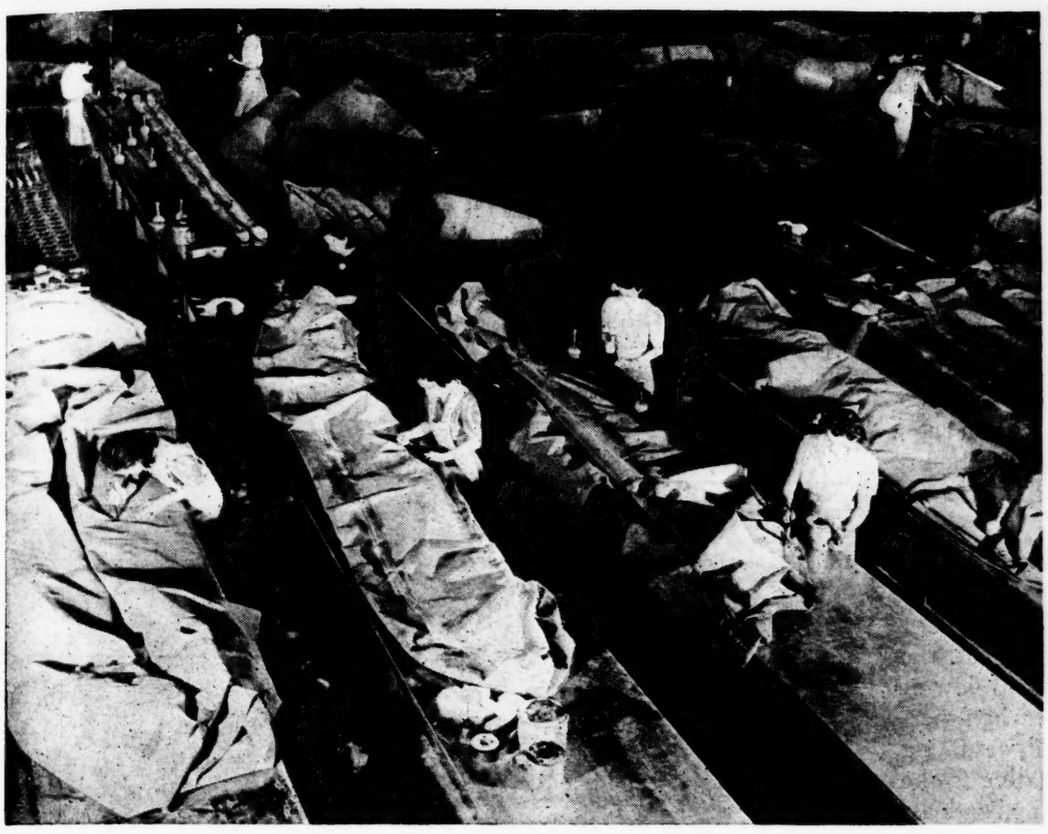
The overall dimensions of the unit are 18 in. high, 37 in. long (spanwise) and 27 in. deep. Its weight is 115 lbs. The estimated increment of the supercharger drive system weight that is chargeable to the refrigeration function is 100 lbs per airplane. The increase in the weight of the ducting is about 35 lbs, bringing the total weight to 250 lbs or 25 lbs per ton of capacity, for a system that ideally meets all of the airline requirements.

The problem of ground cooling without engines operating is simplified to the extent that it requires only a supply of compressed air about 15 lb per sq in. gage pressure. This can be furnished from a central compressor in the air terminal or from individual truck-mounted units. This truck arrangement is based on using a converted aircraft turbosupercharger as the compressor by replacing the turbine with a step-up gear train. A water-cooled truck-type engine is used as the power source. A single axial fan provides coolant air flow for the truck-mounted intercooler as well as the engine radiator. A 5 kilowatt generator supplies power for the operation of the cabin fans and other electrical equipment in the airplane.

Comparison of Installation and Performance

It is apparent that the air cycle has a very definite advantage over the other systems when weight and space requirements are considered. From the standpoint of maximum power required it is the least favorable of the three although the duration of this maximum power load is short. The average cooling load for the Los Angeles to New York operation is only 24% of the maximum. The corresponding average power required for the air cycle is 20% of the maximum power. For the Los Angeles to San Francisco flight the corresponding average values are 71% of maximum cooling and 58% of maximum power.

The relative amounts of fuel required to operate the equipment as well as that to transport it are greater for the air cycle; but of much more significance than the amount of fuel alone is the relative sacrifice in airplane revenue which is limited by the take-off gross weight of the airplane and is proportional to the weight of the equipment plus operating fuel.



Application of sealing compounds to collapsible boat fabrics involves wide exposure of volatile solvents and requires special attention to bench-top ventilation. This month, Mr. Hemeon clarifies the components of convectional ventilation of such bench areas.

Ventilation Requirements for Industrial Solvents—Part 2:

CONVECTIONAL DISPERSION

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SYSTEMS of general ventilation of the simplest type often maintain satisfactorily low concentrations of solvent vapors, e.g., a propeller fan in an outer wall exhausting air from the workroom or an air supply system without duct work. Similar arrangements are equally common that are quite unsuccessful in keeping concentrations low in the breathing zone of the workers, even though the general room air concentration *is* satisfactory.

The present article discusses factors influencing this result. We present a method of analysis permitting the engineer to judge from his drafting board whether the simple system may be adequate, provided he has certain information relative to the proposed process. He is thereby, frequently in a position to judge the need for more elaborate equipment, permitting preparation of more accurate cost estimates.

Consider the evaporation of a solvent and the relative concentration of its vapors at varying distances from a flat surface, e.g., a floor or bench top, and the obvious fact that concentrations of vapors continually decrease with distance from the source. The cause of the decrease is in the action of convection currents of air that are always active and have minimum velocities of 10-20 fpm in what we consider "still atmospheres." Molecular diffusion is by comparison so slow as to be completely negligible.

Convection Ventilation Rate

In Fig. 1 are represented convection currents above the surface of a plane where a solvent evaporates, idealized to the extent that only horizontal components of actual currents are shown. At any given instant of time the inward flow of air must exactly equal the outward flow from any volume of space we may wish to consider.

Assume the space in this figure to be enclosed by an imaginary surface that permits free movement of air currents inward and outward—the boundaries located so that concentrations of vapor are approximately equal at all points of the surface. Assume that air currents in the vicinity are chaotic and cause approximately equal dispersion in all directions horizontally and vertically, and are active within the

space, not only to mix incoming surrounding air with the vapors but also to carry them both upward and laterally.

The quality of any air that passes outward through the imaginary boundary is related to the rate of evaporation and to the rate of ventilation of the space. If v is allowed to represent the average velocity of the convection currents in this vicinity and a, the total area of the surface, it follows that the average convection ventilation rate, Q_c, for the space within the boundary is:

$$Q_c = \frac{v\ a}{2}$$

The factor 2 in the denominator is warranted because only half the area is available for inward flow at any instant. The other half permits equal flow outward, assuming uniform velocities. Relative to the space we are considering, and assuming the surrounding air to be also somewhat contaminated by evaporation from the present or from other sources in the room, the following is also true:

TABLE 4.—BOUNDARY CONVECTION AREAS AND CONVECTION VENTILATION RATES, FOR USE IN COMPUTING VAPOR CONCENTRATION GRADIENTS

CIRCUMSTANCE	DEFINITION	BCA (SQ FT)*	Q_c (FOR v = 15) (CFM)**
CLOSE WORK	**Working distance 1 ft**		
Small evaporation area	Less than 6"-8" in diameter	6½	50
Large evaporation area	Greater than 12" in diameter	LW + 2 (L + W)	8 (LW + 2L + 2W)
Strip evaporation	Greater than 2'-3' long, and narrow	π L	25L
LONG ARM WORK	**Working distance 2 ft**		
Small evaporation area	As above for "close work"	25	200
Large evaporation area	As above for "close work"	LW + 4 (L + W)	8 (LW + 4L + 4W)
Strip evaporation	As above for "close work"	2 π L	50L

*BCA = Boundary convection area = a.

**Convection ventilation rate, $Q_c = \frac{v\ a}{2} = \frac{15a}{2}$

For use in formula:

$$\Delta M = \frac{2}{v\ a} \cdot N \cdot D_r \cdot C$$

$$= \frac{N}{Q_c} \cdot D_r \cdot C$$

$$\begin{Bmatrix}\text{cfm vapor from}\\ \text{ambient air en-}\\ \text{tering the space}\end{Bmatrix} + \begin{Bmatrix}\text{cfm vapor}\\ \text{originating}\\ \text{within space}\end{Bmatrix} = \begin{Bmatrix}\text{cfm vapor}\\ \text{leaving}\\ \text{the space}\end{Bmatrix}$$

$$\text{or } C_a \frac{v\ a}{2} + q = C_x \frac{v\ a}{2}$$

$$(C_x - C_a) = \frac{2\ q}{v\ a} \quad \text{.....(1)}$$

Where

C_a = average concentration of vapor in ambient air entering space (volume fraction)
C_x = average concentration in air leaving the space at boundary
v = average velocity of convection currents, fpm
q = cfm vapor formed by evaporation within space
a = area of bounding surface, i.e., Boundary Convection Area, sq ft.

Natural convection currents in occupied spaces are known to equal or exceed 10 to 20 fpm at all times and it will be conservative, therefore, to let v = 15. It is more convenient to deal with concentration figures in parts per million than in the decimal fractions of C_a and C_x, hence in the following formula

Let M_a = average concentration of vapor in ambient air (ppm)
M_x = average concentration in air leaving the space (ppm)

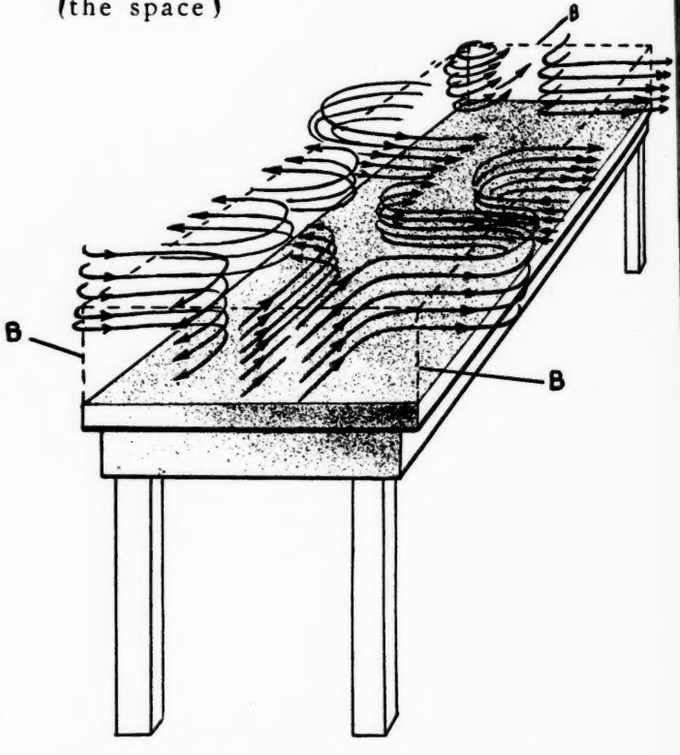

Fig. 1. Idealized representation of chaotic convection currents above surface of a bench. Only horizontal components of velocity are shown. Rectangular enclosure, B, is Boundary Convection Area, a combination of 5 imaginary planes constituting a frame of reference for evaluating the magnitude of "convection ventilation rate."

$$\text{Then } M_x - M_a = \frac{2\ q}{v\ a} \times 10^6 = \frac{2\ q}{15\ a} \times 10^6 \quad \ldots(2)$$

Still another and more convenient form of this relationship is derived below.

$$q = \frac{N \cdot D_r \cdot C}{10^6}$$

which when substituted in the equation (2) gives the general form

$$M_x - M_a = \Delta M = \frac{2}{v\ a}\ (N \cdot D_r \cdot C) \quad \ldots(3)$$

Where N = rate of evaporation, pints per minute or pounds per minute (use same units as for D_r)

D_r = dilution rate, cubic feet per pint, or cubic feet per pound, from Table 3, Part 1, December H&V (use same units as for N)

C = Ventilation Design Concentration (corresponding to D_r)

If we can estimate the area of the surface that constitutes the locus of all points of equal concentration, where the height of the surface is selected to coincide with the worker's breathing level, then we can calculate the factor ΔM which is a measure of the concentration gradient in terms of distance from the source.

What maximum value of ΔM should we take as indication that concentrations at breathing height will have decreased to a satisfactory level? We recommend the following as a good practical rule: if the differential, $M_x - M_a$, does not exceed the ventilation design concentration by more than 50% no special auxiliary measures will be required and a simple system of general ventilation will suffice. If it does exceed this level auxiliary measures *might* be required.

Boundary Convection Area

The true locus of all points of equal concentration would be a curved surface, the geometry of which depends on mathematics too complex to be useful. The simplifying assumptions we propose below all are selected for a conservative result and consideration of them will make it apparent that greater accuracy in estimation of the true boundary convection area is unwarranted.

Point Source

The evaporation of solvent from a point source on an infinite plane would result in a B.C.A. that is hemispherical in shape, provided we assume equal dispersion of vapor in all directions from the source. The assumption is incorrect for there is, in fact, a tendency for flattening of the surface that is the locus, close to the source, due to the slightly greater density of the air-vapor mixture. (The cooling effect of the evaporating solvent, and the presence of higher solvent vapor content of the mixture account for this condition.)

The simplification, however, leads to a mathematical treatment that is simple and therefore practical for application to design problems. The nature of the inaccuracies is satisfactory because they lead to conservative conclusions.

The boundary convection area, then, for the case where the source of vapor is small in area relative to the distance, *x*, between it and the boundary surface which coincides with the breathing zone, approaches that of a hemisphere.

$$\text{B.C.A.} = 2\pi x^2$$

We shall call this case, "small area evaporation."

Area Source

"Large area evaporation" is a suitable term describing the more common case where the distance from the source of vapor (bench or floor) is small compared with the dimensions of the area of evaporation. As the distance, *x*, approaches zero the boundary convection area approaches, as a limit, the area of the evaporating surface itself. Conversely, as the distance increases, the sides of the B.C.A. begin to assume importance. The surface will, obviously, be curved but its geometry is complex.

With all facts taken into consideration it appears that a rectangular surface represents well enough the shape of the boundary convection area, permitting a rough estimation of its area. The rectangle is one whose base encloses the source of evaporation, and whose top is a plane of the same area and at a height "x" that coincides with the breathing level of the worker.

The boundary convection area for this case, therefore, where the area of evaporation is large relative to the distance, *x*, from it to the breathing zone is well represented as follows:

$$\text{B.C.A.} = LW + 2x\ (L + W)$$

L = Length of evaporation area

W = Width of evaporation area

Strip Source

There is one other form occasionally encountered wherein the solvent evaporates from a long narrow strip, as in the application of cement to long seams in certain rubber fabricating operations. We may simplify the picture of this case to the extent of considering the source as a line (without area) as we considered a point source above. The boundary convection area would then be

$$\text{B.C.A.} = \pi\ x\ L$$

with the symbols having the same significance as above.

Operations are frequently encountered that do not appear to fit any of these forms. In such cases one can arbitrarily select a shape resembling it most closely. For example, in many of the operations incident to the fabrication of fuel cells for aircraft the cementing results in solvent evaporation from a

cubical shape. We recommend that an imaginary plane be passed through the principal cementing areas, perpendicular to a line from the worker's breathing zone to the source of vapors, and that the plane be considered as a solid barrier, as though it were a bench or floor. This will result in a calculated result that is conservative and has the virtue of simplicity.

Also one may, if the characteristics of the operation so indicate, consider the B.C.A. to be greater than the result by the above method, by the ratio of the angle of free space, to 180°. This will usually be an increase of $\frac{270°}{180°}$ or 50 percent above that of a plane.

Convection Velocity

For calculating the convection ventilation rate, we have used a convection velocity of 15 fpm in lieu of an experimentally determined value. It is a reasonable figure for a space having a low rate of ventilation relative to its dimensions.

In some cases the room dimensions relative to the ventilation rate will be small enough to indicate a higher convection velocity. (A more extended discussion of convection velocities will follow.)

Working Distance

The working distance between the worker's breathing zone and the source of vapor is a factor of importance since it determines in part the B.C.A. In our experience the distance is practically never less than one foot nor more than two feet for manual work at benches or on a floor. We find it convenient to consider these two extremes as fixed values for the tabulation of design data, which we shall refer to as "close work" and "long arm work," respectively.

Design Data Summary

The product of the convection velocity and the B.C.A. divided by two is the convection ventilation rate, appearing in formula (3). This permits the calculation of the natural dispersion rate and the reaching of a decision as to the need for auxiliary means to the general ventilation.

In Table 4 we have summarized the design data for the special cases and conditions indicated. It should be noted that the last column, Convection Ventilation Rates, is based on a still atmosphere where we estimate an average convection velocity of 15 fpm.

Examples

Example 1. Cementing is done on a bench with solvent evaporating over a gross area of 4 ft × 3 ft. The worker's breathing level is about one foot above the bench. The solvent is orthodichlorbenzene and is consumed in the area at a rate of ½ pint per hour. The question is whether simple general ventilation will be adequate to prevent too high concentrations at the worker's breathing level.

Solution—We determine the minimum differential, ΔM, between the concentration in the ambient air and that at worker's breathing level, by the relationship given. The data are selected as follows:

From the description given, the operation is classed as "close work," and "large evaporation area." Reference to Table 4 gives the convection ventilation rate, Q_c. The data are as follows:

$$Q_c = 8\,(LW + 2L + 2W) = 210 \text{ cfm}$$
$$N = \tfrac{1}{2} \div 60 = 0.0083 \text{ pint per minute}$$
$$D_r = 74{,}000 \text{ cu ft per pint (from Table 3)}$$
$$C = 50 \text{ ppm (from Table 3)}$$

Substitution of these data in the equation gives

$$M = \frac{(0.0083) \times 74{,}000 \times 50}{210} = 145 \text{ ppm}$$

Since this differential exceeds the design concentration of 50 ppm by much more than 50% we conclude that auxiliary measures are necessary beyond simple general ventilation. In unfavorable and unpredictable conditions the worker might be exposed to concentrations of 200 ppm.

Example 2. With other conditions of Example 1 the same, assume that the rate of solvent evaporation is ½ pint per 8 hours. In this case:

$$\Delta M = 20 \text{ ppm}$$

which indicates that with a general air concentration averaging 50 ppm, the worker could not be exposed to more than 70 ppm as a maximum and this is satisfactory.

Example 3. Methyl ethyl ketone evaporates from benches of 60 workers at a rate of ½ pint per hr at each work place. The work room is 30 ft × 50 ft × 10 ft and we shall consider the adequacy of a simple ventilation system in which a propeller fan is to be placed at one end of the work room with the air supply at the opposite end. The operations are intermediate between "close work" and "long arm work" with an estimated working distance of 18 in. from bench top to breathing zone. The principal evaporation takes place in a gross bench area, at each worker, of two feet square.

Solution—The B.C.A. is estimated on the basis of the average of the formulas for "close work" and for "long arm work" of Table 4.

$$a = (LW + 3L + 3W) = 16 \text{ sq ft}$$

The convection velocity will be greater than 15 fpm as will be seen from the following: from Table 3 we find that D_r for methyl ethyl ketone must be 31,000 cu ft per pint. Since the total evaporation is

$$\frac{30 \times 1}{60} = \tfrac{1}{2} \text{ pint per min}$$

the ventilation rate for the room will be a minimum of

$$31{,}000 \times \tfrac{1}{2} = 15{,}500 \text{ cfm}$$

The vertical cross-sectional area of the room is 300 sq ft and with a general horizontal travel of air the average velocity of air in the room will be

$$\frac{15{,}500}{300} = 50 \text{ fpm}$$

a value we use for v, instead of 15 fpm as in conditions of "still atmosphere."

It is now clear that

$$Q_e = \frac{50 \times 16}{2} = 400 \text{ cfm}$$

We may now calculate $\triangle M$ on the basis of the following data:

$$N = \frac{1}{260} = 0.0084 \text{ pint per minute}$$

$Q_e = 400$ cfm
$D_r = 31{,}000$ cu ft per pint
$C = 150$ ppm

Substitution in the equation for $\triangle M$ gives:

$$\triangle M = \frac{0.0084 \times 31{,}000 \times 150}{400} = 95 \text{ ppm}$$

The differential exceeds the design concentration by somewhat more than 50% and the conditions are therefore not completely satisfactory according to this arbitrary rule. However, a consideration of other practical factors is helpful in deciding whether to proceed with an elaboration of the design. In the first place the worst condition that might occur, as indicated by the above calculations, is an increase in concentration of vapor at the breathing level, of about 100 ppm over the planned general air concentration of 150 ppm, or 250 ppm. An important consideration, however, is that there is no evidence that this solvent is toxic in these concentrations. It is, rather, an odor nuisance. Recognizing the conservative nature of the assumptions that led to the method of computation, we may hope for a better result than is indicated.

Finally, we may balance the relative cost of additional measures against the risk which is not one of worker poisoning and take into account also the standards of ventilation peculiar to the plant in question. We would conclude that no auxiliary ventilation devices need be included in the original design.

It is clear from the analysis presented in this article that the magnitude of convection velocities is of great importance in determining concentrations of vapor in the breathing zone. We take 15 fpm as a conservative value for a still atmosphere, although values double this figure are probably common.

The dispersion of vapors may be increased three to four times by the simple expedient of mechanically inducing air currents of higher velocity, as by blowing, in the space between the breathing level and the source.

A small propeller fan driven by a pneumatic motor would be a practical device for this purpose. The need for costly special electric motors in the presence of flammable vapors rules out an electrically driven unit.

An air jet at a low rate of air flow can also serve the same end. Located at a suitable distance from the critical zone it will entrain from surrounding air several times its original volume while its average velocity decreases to a reasonable level.

The comfort of the worker in winter time is a limiting factor in any scheme to increase velocities by fan or jet and, since human sensitivity to drafts is related to air temperature, such devices cannot be installed haphazardly. If proper analysis indicates a maximum permissible velocity of 50 fpm, for example, then $\triangle M$ must be recalculated on the new basis to ascertain whether the necessary conditions will be attained.

Local exhaust without duct work designed to draw all vapors from their sources and discharge them back into the room may be used for these purposes. It is the exact opposite of the blowing systems discussed above and is not subject to the same limitations. In ordinary factory problems an arrangement of this type would only be economically applicable in special circumstances where there were great difficulties in running exhaust pipes to the exterior, or where only one or two benches were involved. Space, also, must be available for discharge of exhaust air in such a manner as to avoid discomforting drafts. In a later article we describe an interesting application of this method.

Dust-Proof Regulator

Hagan Corporation, combustion engineers, reports development by a southern engineer of a new feature for combustion control regulators to meet conditions where fine dust in the air stops up the regulator mechanism.

The improvement was in the plant of the Southern Box & Lumber Co., Wilmington, N. C., where G. Colucci, president, reported the difficulty.

At the suggestion of J. T. Potter, Hagan and Hall Laboratories representative in that state, the engineer not only enclosed the regulator in a box to keep out the fine dust, but went one step further by running in a compressed air line and keeping a little positive air pressure in the box. This procedure made more certain that the regulator would stay clean.

Mr. Colucci says the company would not part with the regulator at any price if it could not get a duplicate.

Incidentally, this is a solution to fine-dust problems which could be of value in many other industries.

Air Cleaners for Internal Combustion Engines

Performance characteristics of various types of air cleaners are discussed in this, the second of three parts in the author's comprehensive analysis.

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APPARENTLY, the perfect air cleaner has not yet been invented. Nearly all those on the market have at least one point of excellence, though in some cases the point may be of minor significance.

Plain Dry Filters.—If the material is loosely woven or packed, plain dry filters may stop practically 100% of the dust at first, but may later release that previously caught and allow it to pass on into the engine. If, on the other hand, the material is felted or very closely woven, it may continue indefinitely to stop practically all the dust; but, as more and more dust is caught, the restriction may increase to such an extent that loss of engine power may cause the driver to remove the cleaner. This has often occurred, especially when fog or oily vapors have reached the filter. Cement dust seems to have a marked tendency to clog such filters. If the surface area of a felt filter is large for the rate of air flow and if the spacing leaves sufficient room between parts, the rate of increase of restriction and resulting loss of power will be slow and the service more satisfactory. Dry felt filters are slightly less efficient when new; they require a small amount of dust to fill up the larger pores in order to develop their full efficiency. Felt made of frowsy material and having only a small admixture of wool is liable to be lumpy and unsatisfactory for air filters. Filters of such material will show lower dust separation efficiency and, especially after long continued use, higher restriction than good woolen felt.

Filters made of sponge rubber about ¾ in. thick have been used to some extent as air cleaners. The efficiency is high and the restriction not excessive. They are serviced annually by rinsing and washing in water. If filter elements of felt or cloth must be taken out and dusted or washed either in water or gasoline, holes are liable to be made in the material, particularly if the surface is unprotected (as by a screen). Such filters have been found so full of holes that the efficiency of dust separation, instead of being nearly 100% as at first, was reduced to about 50%. If a dry felt filter is washed in oily gasoline, the oil remaining tends to make the restriction increase more rapidly. Representative dry filters are shown in Figs. 1 and 2 (first part).

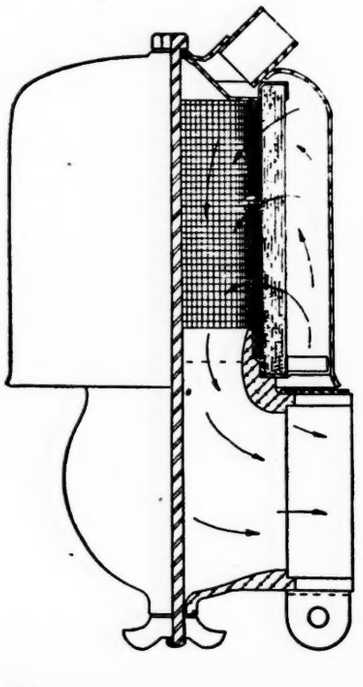


Fig. 6. Winslow (shown partly broken away). Centrifugal action is caused by inclined vanes in the air inlet to the bell-shaped cover. The cylindrical oily screen filter is washed down by crankcase vapors which condense in a circular trough at the top and are distributed over the filter and on the inside of the shell.

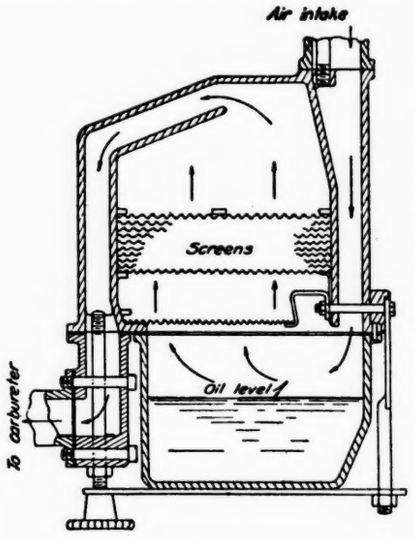


Fig. 7. Case tractor air cleaner (section view). The coarser dust tends to pass directly into the oil in the reservoir because of the inertia effect as descending air stream abruptly changes direction just above the surface of the oil in the reservoir.

Plain Oily Filters of Organic Fibers, Not Self-Washing.—If sufficiently thick and of loosely packed material, plain oily filters of organic fibers show efficiencies well above 90% and in some models satisfactorily low restriction. If they are washed with gasoline, dried, and re-oiled at proper intervals, these good qualities are maintained. If the cleaner is not serviced, the fibers (or meshes) of the filter become heavily coated with dust, especially along the paths of least resistance through the filter. When all the oil on these fibers has been absorbed the restriction usually does not rise excessively, but the oncoming dust and sand wear off the encrusted dust from the fibers and eventually polish them clean, leaving small dry tunnels through the filter. There-

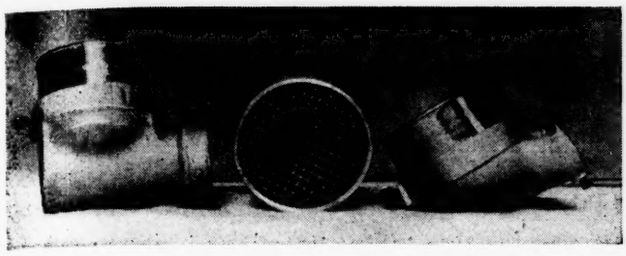


Fig. 8. Earnest. Oily braided metal-ribbon filter cleaners for Buick and for Model A Ford, respectively. Filter element in the middle (same for both models shown) is made of non-corrosive materials.

after only the coarsest dust and a small percentage of the fine will be stopped. This type of cleaner is, however, easily serviced, excels in simplicity and small size, and does not greatly interfere with carburetor action even when neglected, unless insects, chaff, or leaves in appreciable quantity get in. A coarse screen over the inlet may obviate this difficulty.

If the oily fibrous material is closely packed, the cleaner is likely to maintain high efficiency, but have higher and higher restriction as dust is taken in, causing too rich a mixture, unless a balanced tube carburetor is used. As the restriction increases the filter unit may be forced out of its usual position, leaving passages between it and the walls of the container.

Oily Wire Screen Filters, Not Self-Washing.—Such filters are usually made of insufficient thickness to stop more than 30 to 50% of the dust; but, as ordinarily constructed, they offer very little restriction because of their extreme looseness or openness. For this reason their capacity for holding oil is very small, being somewhat less than that of the loosest of curled-hair filters and about 1/12 that of pasteboard cleaners of the same size. Hence they need washing and re-oiling more frequently, except when used on some of the old model machines in which the space under the hood may be covered with sufficient oil spray to keep the wire screens moist. If not re-oiled frequently, this type speedily loses nearly all its power to separate any but the particles that are larger than the meshes of the screen. It should be remembered in this connection that the great bulk of the dust which an air cleaner is called upon to eliminate will pass through a 325-mesh-per-inch screen (less than 44 micron particles).

Oily Metal Ribbon and Kinked Wire Filters, Not Self-Washing.—These filters are usually intermediate, as to efficiency, restriction, and frequency of servicing required, between oily curled hair (or other organic fiber) loosely packed and loose oily screens. The thinner and looser the filter the lower the efficiency and the more frequent the need for servicing, but the smaller the restriction effect. Steel wool usually has characteristics between kinked steel wire and curled-hair.

Oily Pasteboard-Type Cleaners. — Oily pasteboard type cleaners vary in efficiency from about 70% to 95% or better, depending principally upon the thinness of the pasteboard and the kind and amount of oil used. If the pasteboard is thinner than about 1/32 in., accumulating dust may raise the restriction and cleaning may be required oftener than once each 5,000 miles. If thicker than about 3/32 in., the efficiency is materially reduced. This type differs from the oily types previously mentioned in that the pasteboard itself acts as reservoir for several ounces of oil, which oozes out as needed to moisten the dust. An English cleaner using oil-saturated wood chips as the filter material is somewhat similar to the pasteboard type both as to efficiency and mode of operation, but is probably not so easy to clean. See Fig. 12.

Self-Washing Oily Filters.—Self-washing oily filters are in use on many modern tractors, on some buses and trucks, and in cases where dust conditions are severe, as substitute equipment on automobiles. The chief reason for this selection is the possibility of securing high efficiency with constant and not too high restriction and with extraordinary capacity for handling dust. Disadvantages usually present in this type are the large size and the need of being placed in the vertical position. Self-working oily filters, whether of organic fibers, kinked wires, metal strip, or woven or expanded metal screens, and self-washing oily surface cleaners, maintain their original efficiency and restriction practically constant as long as the washing fluid (usually oil) is doing its work. In some makes of cleaners the washing action is very vigorous and effective; in others, weak and inadequate.

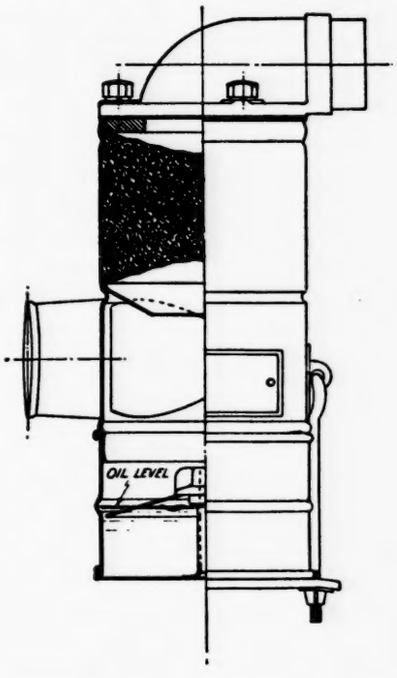


Fig. 9. Vortox (shown partly broken away). Air entering by the tangentially placed tube at the left throws the heavier dust against the oily walls of the cup and by a cyclonic effect sprays oil up into the kinked steel wire filter. The oil and dirt washed from the filter return to the cup by a special passage. The cone in the cup prevents excessive oil spray at high air speeds.

The efficiency of self-washing oily filter cleaners may be as low as 70% or 80% or as high as 97% to 99%. If the filter is too loose or too thin, or the material unevenly placed, the efficiency is lower. Manufacturers are often tempted to put out thin filters because of the low restriction effects. Another factor markedly affecting efficiency is whether much of the dust is disposed of at once in the oil cup or whether all must be caught by the filter proper.

The length of time the cleaner will serve before

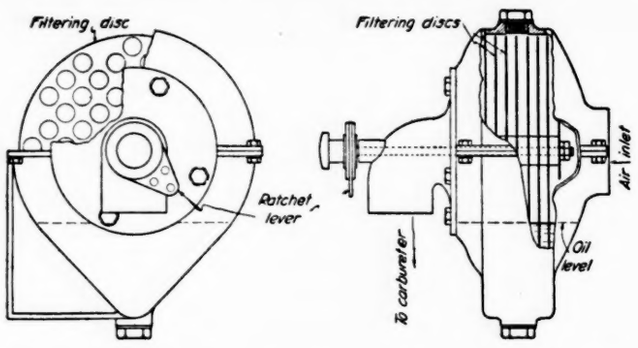


Fig. 10. Visco Rotary (shown partly broken away). The plates revolve slowly with their lower segments dipping in oil. The perforations in the plates are staggered. This cleaner is used on many military trucks in India.

all the oil is absorbed depends on (1) the volume and volatility of the oil, (2) the average rate at which the engine draws air through, (3) the average temperature and dustiness of the air, (4) the position of the air intake, and (5) whether any oil goes over into the carburetor.

Deterioration in Oily Fiber Filter.—The fibers, if loosely packed, may wear and break after long use because of vibration or may rearrange themselves so as to leave relatively large passages through which the air may pass uncleansed. In some cases, the oil itself may possibly cause or hasten disintegration of the fibers. Loose pieces from a disintegrating filter may clog carburetor passages. For similar reasons steel wool may cause trouble if substituted for kinked hard-drawn steel wire or copper ribbon. Corrosion troubles have been reported in cases where the dissimilar metals chosen for filter and container have set up electrolytic action when moisture was present.

Oily Metal-Plate Type Cleaners.—Metal plate cleaners are capable of very rugged construction and are not adversely affected by extremes of air temperature. They are usually similar to the oily screen type as to efficiency, but as a rule have somewhat higher, though constant, restriction. In some cases they are made self-washing by rotating circular plates with the lower segments dipping in oil. See Fig. 10.

This type may be made of the required efficiency by using a sufficient number of plates or by adding wire screens between adjacent plates. In one make of this type the plates are formed to a certain curvature so that inertia (centrifugal) effects aid in bringing dust particles into contact with the oily surfaces especially at high speeds (air speeds). When the metal plates are rotated at very slow speeds the washing is usually satisfactory and no oil entrains, but if the rotation is too rapid, drops of dirty oil are liable to go over into the carburetor.

A cleaner of somewhat similar type consists of a helicoid of metal fixed in a tube through which the air is made to pass. A tube coming from the crankcase acts as a ventilator and brings vapors of oil and

Fig. 12. Bowden cleaner. Pasteboard rings typical of the two forms placed alternating in the pile that makes up the filter element. Note that some dust adheres to the flat surfaces.

water to moisten the surfaces of the cleaner. Unless adequate provision is made to prevent it, the condensed oil and water vapors will flow along the inside surfaces of cleaners of this type, carrying the dirt along into the carburetor. See Fig. 13.

Another modification of the oily metal-plate type is in use in Germany and elsewhere in Europe. The dusty air is made to pass through a filter consisting of a mass of oily thimbles (made by cutting off short pieces of metal tubing). The efficiency is good if sufficient depth of filter is used and the thimbles are frequently washed and re-oiled. The restriction is not excessive if the proper area of filter is chosen, but the device is bulky.

Inertia-Type Cleaners.—These cleaners (almost all of which are dry centrifugal) are as a rule unable to handle satisfactorily anything except the coarser dust particles. Designers sometimes raise the efficiency by restricting the area of the inlet passages where the whirling motion is imparted, but when this is done the restriction is increased and may become prohibitively high at high car speeds. Further, at low speeds and consequent slow flow of air through the cleaner, the power to separate the dust particles is almost entirely lost. Experience has shown repeatedly that cleaners of this type do not furnish adequate protection under severe dust conditions. Tables given in Bulletin 499 of the University of California Experiment Station illustrate and show

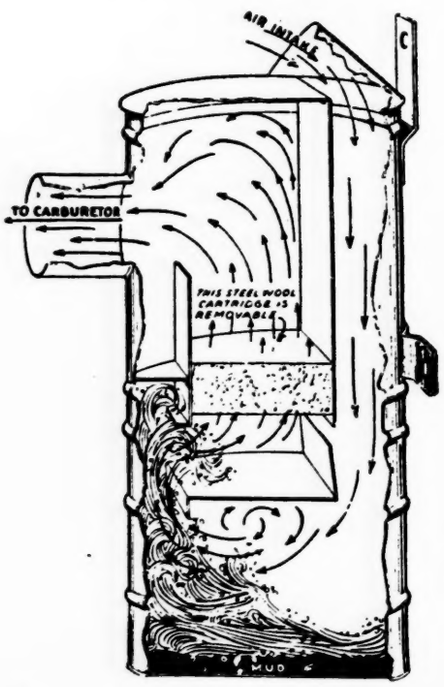


Fig. 11. Ellis self-washing oily steel-wool filter.

clearly the inability of this type to completely clean the air.

Contrary to common opinion, dry centrifugal-type cleaners offer very considerable restriction especially at high car speeds. The length of time since the last servicing will, however, usually have little effect on the restriction. Though cleaners of this type do not require very frequent servicing, they do need occasional attention to maintain even their low efficiency. If there are dust-outlet slots, they may become clogged with oily dirt, the bodies of insects, or bits of chaff and leaves. See Fig. 14. The vanes may become heavily coated with dirt and become less effective. The moving parts, if any, may become worn or loaded down with accumulations of dust and oily vapors so that their action may be impaired or cease entirely. If gas from the exhaust manifold is used to eject the separated dust, carbon will accumulate in the venturi throat, upon the action of which the functioning of such ejectors depends. If, however, an engine is in good condition and adjustment, with little carbon in the exhaust, the throat of the cleaner should not require cleaning out oftener than once in four to six months of normal operation.

The air leaving a dry centrifugal cleaner may still have considerable whirling motion when it enters the carburetor. This may interfere with carburetor action in some machines at certain speeds. Usually cleaners of this type have a device for straightening air flow.

Inertia-type cleaners using the blast from the radiator fan as an auxiliary are found to have the limitations common to the inertia type and in addition are handicapped in that they must necessarily be placed where the dust concentration is greater than at some other places under the same hood. Their small servicing requirements made them popular a few years ago, but they have now practically disappeared.

Water-Type Cleaners.—These cleaners are still used on a few tractors but are in general too heavy and bulky for use on road vehicles. They have become unpopular even for tractors chiefly on account of

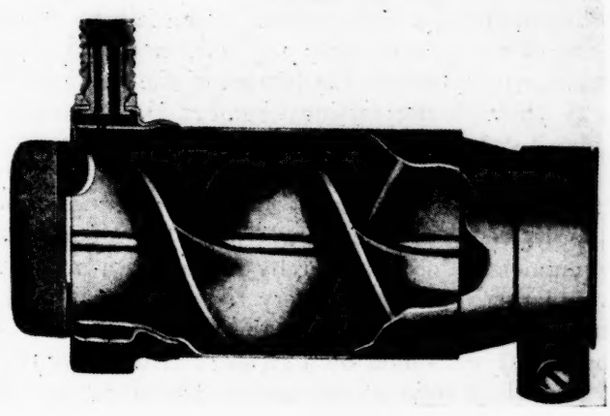


Fig. 13. Remington (shown partly broken away). The removable helicoid may be washed and dipped in oil. The crankcase connection (upper left) serves to help maintain oiliness of the surfaces.

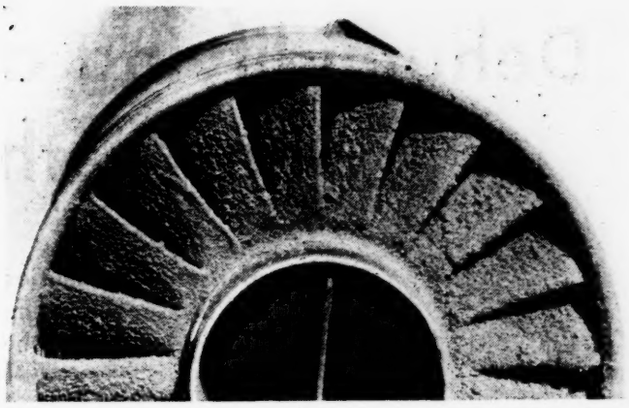


Fig. 14. Even a dry centrifugal air cleaner needs some attention. After about 20,000 miles use the vanes may become loaded with oily dust and need washing off. The partition across the outlet is designed to take the whirling motion from the air before it enters the carburetor.

(1) the large amount of care and attention required; (2) the tendency, especially of some constructions, to get out of order; (3) the danger of freezing; and (4) the danger, under certain circumstances, of water going over into the carburetor. Some makes have given excellent service on tractors. These records result from extra-large water capacity, robust construction of interior parts, adequate provision against clogging by chaff, leaves, and insects, and care in placing the air intake so as to avoid the bulk of the dust. Some recent work of the Bureau of Standards shows that moistening the air entering the carburetor reduces detonation and makes for smoother running, but may reduce power by as much as 8 or 9% in extreme cases. The latest development is the addition of alcohol-water mixtures to the inlet air. Power is increased almost 20% and smoother performance is obtained.

Combinations.—The possible combinations were discussed under the general classification of air cleaners. Sometimes two cleaners are placed in series. Generally in such cases an inertia type is placed ahead of a filter with the idea of decreasing the work of the latter and hence increase the time between servicings. Placing two cleaners in series on an automobile is in the main unsatisfactory because the combined restriction of the cleaners and their tubular connections is too high and because the cost and space requirements are larger. The use of more than one principle of dust separation is found in several of the most satisfactory cleaners. In such cases skillful designers have combined and proportioned the several parts so as to avoid excess restriction and secure good dust separation.

Diesel Engine Air Cleaners.—The chief types of air cleaners used on the intake of air for the Diesel engine are impingement type, cellulose fiber, and oil bath and screen types. It is desirable to install a manometer on stationary Diesel engines for occasional reading of the pressure drop through the air filter in order to keep check on its condition. The filter area should be great enough to limit the pressure drop to not over 2½ in. of water.

Next month the author discusses the effect of the position of air intake on the efficiency of air cleaners.

Dehumidifying and Air Sterilization with Triethylene Glycol

The water-absorbent qualities of the liquid triethylene glycol are put to work in a new system of dehumidification which has many applications and includes the added feature of air sterilization.

DEHUMIDIFICATION equipment employing triethylene glycol [$(HOCH_2CH_2OCH_2)_2$] as the dehumidifying agent, was announced jointly by Research Corporation, New York, and the Rogers Diesel & Aircraft Corporation, New York, at a meeting held December 17. The system was developed by the former company, a non-profit organization, which has licensed Rogers Diesel & Aircraft Corporation commercially to exploit the apparatus developed to carry out the cycle. The system, which has been named the Rogers-Research system of air conditioning, has, in addition to the dehumidifying function, a second feature—that of sterilizing the air. This results from the introduction into the air stream of minute portions of triethylene glycol which has important antiseptic properties. It is applicable to industrial and comfort air conditioning.

The system consists of two major pieces of equipment—the absorber and the concentrator, as shown schematically in the accompanying drawing.

Cycle and Equipment

The absorber is the dehumidifying and air cooling unit. It consists of a steel shell into which the air to be dehumidified is drawn by a blower. Within the shell is also located a cooling coil, spray nozzles, a spray eliminator, air filter, and the sump in which the triethylene glycol supply is contained. The spray nozzles are mounted over the cooling coil. The motor driven pump is mounted outside the shell for circulating the triethylene glycol.

Air to be dehumidified is drawn through the air inlet at one end of the absorber. It passes over the cooling coil at the same time that the glycol solution is being sprayed over the coil. Thus, the incoming air is contacted with and washed by the glycol spray. The air continues over the coil through the shell, through the spray eliminator (to eliminate entrained droplets of glycol solution), through the air filter, then through the blower and out of the absorber dehumidified to the desired condition called for by the controls.

Cooling water flowing through the cooling coil serves to reduce the temperature of the incoming air passing over the coil. Further, when water vapor from the air is absorbed by the glycol there is heat released into the air because of the fact that the water vapor (which is actually steam) is converted into water and the latent heat of the water vapor is released into the air and glycol solution in the form of heat. This heat is also absorbed by the cooling coil. Regardless of the temperature of the air entering the absorber, it will leave at a temperature 5F higher than that of the water entering the cooling coil.

In the process of dehumidifying the air, the triethylene glycol supply in the absorber becomes diluted with water. It therefore becomes necessary to reactivate the glycol (or to drive off from it the water it has absorbed) so that it will retain its moisture absorbing powers. This reactivation process is continuous in the system. Roughly 25% of the triethylene glycol supply in the absorber system is continuously by-passed, by the absorber pump, to the concentrator for reactivation.

Use of the concentrator is based upon the fact that when a solution of triethylene glycol and water is heated to about 225F, and then placed in contact with air, the water in the solution will evaporate into the air, leaving undiluted triethylene glycol.

The arrangement of the concentrator is shown in the sketch. It also consists of a steel shell. Attached to the concentrator is a shell-and-tube type heat exchanger or solution heater. The triethylene glycol, on the way to the concentrator, flows through the tubes of the solution heater. Low pressure steam is admitted into the solution heater and surrounds the glycol-filled tubes, heating the glycol to about 225F. The steam condenses upon contact with the cold tubes and is discharged out of the solution heater to waste. The heated glycol flows out of the solution heater and into the top of the concentrator shell where it enters a mixing chamber and falls by gravity (the sketch is schematic and does not show exact relative positions) to the bottom of the shell. On its way through the mixing chamber the solution is mixed with a stream of air which is drawn into the concentrator by the small blower mounted on the inside of the concentrator. This blower draws its air supply from the room in which the air conditioning equipment is located, thereby serving as a means of ventilation for the machinery room. The fall of the triethylene glycol through the mixing chamber is broken several times by a series of distributing platforms which serve to increase the contact of air with the triethylene glycol in the mixing chamber.

The heated solution, after it leaves the solution heater to enter the mixing chamber, has a higher vapor pressure than it had before being heated. This

causes the water vapor in the solution to pass into the air in the mixing chamber, leaving the triethylene glycol solution in its original undiluted strength. The air supply in the mixing chamber also becomes heated through its contact with the hot glycol. The heat of this moisture-laden air supply is made use of in the following manner:

Within the concentrator shell is a heat exchanger called the reflux coil through which the cold triethylene glycol solution passes before it enters the solution heater. The hot air being discharged from the concentrator passes out of the mixing chamber and over the reflux coil, increasing the temperature of the cold triethylene glycol flowing through it, thus reducing the amount of heat required to raise the temperature of the glycol solution when it gets to the solution heater.

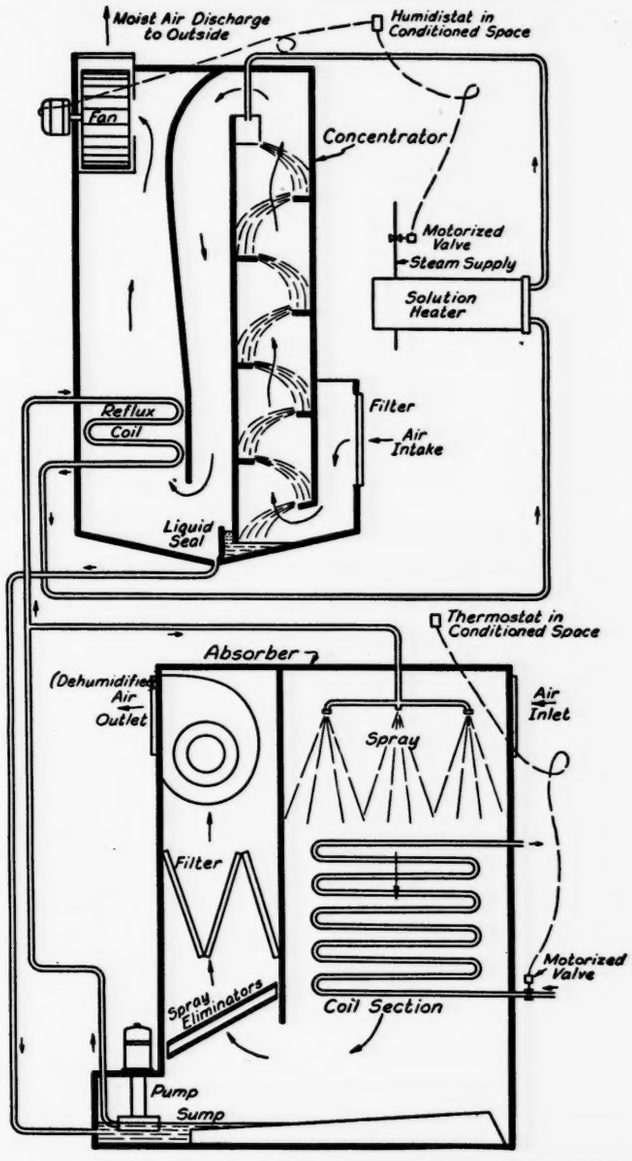
Hot moisture-filled air that passes over the reflux coil contains a certain amount of entrained triethylene glycol vapor that it has picked up in the mixing chamber. When the hot air strikes the cool reflux coil the air-entrained triethylene glycol vapor condenses on the cool coil and falls to the bottom of the shell, joining the reactivated triethylene glycol supply. The main purpose of the reflux coil is to eliminate loss of glycol from the system.

The warm moisture-filled air then passes out of the concentrator and through a duct and is discharged to the outdoors. The reactivated supply of glycol flows out of the concentrator and back to the triethylene glycol supply in the sump in the absorber shell.

Automatic Control

Control of the system is simple and automatic and accomplished by either electric or air operated controls. Humidity is controlled by a humidistat located in the conditioned space. The humidistat controls an automatic steam valve in the steam supply line to the solution heater, and also governs operation of the blower on the concentrator. When the humidity rises, the steam valve is opened and the blower starts. When humidity falls, the steam valve closes and the blower stops. Thus the concentrator system operates only for periods of time sufficient to remove the water from the triethylene glycol solution at the same rate as water is being added to the solution in the absorber. By controlling the strength of the triethylene glycol-water solution, its water absorbing power is controlled and thus its ability to dehumidify air to the desired point. The concentrator works intermittently and its steam consumption varies directly with the load.

Air temperature control is through a thermostat located in the conditioned space. This thermostat controls a motorized valve in the water line to the cooling coil in the absorber. When the temperature in the space to be conditioned is lower than desired, the thermostat acts to regulate the valve and reduces the amount of cooling water entering the cooling coil. The air then leaves the absorber dehumidified, but at a higher temperature. When the temperature begins to rise higher than the desired condition, the thermostat acts to open the valve and permit an increased flow of cooling water to re-enter the cooling coil.



Lower portion of schematic diagram shows dehumidifying section of glycol system while upper portion shows how glycol is reactivated for reuse.

Industrial Dehumidifying

There are cases in industrial air conditioning where the control of indoor temperature is relatively unimportant but where the air moisture content is of considerable concern. In such cases the following table indicates the indoor conditions that could be obtained with this system for such installations.

When available cooling water temperature (F) for absorber coil is.....	60	65	70	75	80	85	90
Then temperature (F) of air leaving absorber will be....	65	70	75	80	85	90	95
The dew point (F) of air leaving absorber will be.....	28	33	37	41	46	50	54

Air in any of the conditions indicated above is at 25% relative humidity.

There are many air conditioning problems which require an installation where, in addition to the control of humidity, low temperature air is also desired, and at a temperature lower than can be obtained from the temperature of the available water supply that would be used in the absorber coil. In such cases, the system would be used with auxiliary equipment to provide cooling for low temperature air. This auxiliary cooling may be integral with the equipment by providing cold well water for the absorber coil, or it may be external in the form of after-cooling-coils utilizing refrigerated water. In many systems, such as those installed for comfort air conditioning, the outdoor air drawn into the absorber is dehumidified to the proper degree. The dehumidified air then leaves the absorber and is independently cooled by the refrigerated after cooling coils to the proper degree to fulfill comfort requirements.

The following table indicates the indoor conditions that could be obtained for such an installation:

When available cooling water temperature (F) for absorber coil is.....	40	45	50	55	60	65
Then temperature (F) of air leaving absorber will be.....	45	50	55	60	65	70
The dew point of air (F) leaving absorber will be.....	12	16	20	24	28	32

Note that the dew point of the air at each of the above conditions is below the freezing point of water. In other words, with this system, it is not necessary to chill the air below the dew point temperature to obtain the desired degree of dehumidification so that there is no frosting involved.

The manufacturer emphasizes that triethylene glycol is non-corrosive and requires no inhibitors; valves, pumps and piping can be of standard materials. The moving parts involved for the basic system are two motor-driven blowers and one motor-driven pump.

Air Sterilization

Tests during the war period have shown that the glycol chemicals when vaporized have the property of killing certain air-borne bacteria, particularly those involved in respiratory illnesses. An extremely small amount of glycol vapor is sufficient to sterilize the air in a large area and the amount of triethylene glycol which is so vaporized and carried over into the air conditioning space by the Rogers-Research system consequently acts as the sterilizing agent.

Tests were reported of two identical buildings at the Lockheed Aircraft Corporation, Burbank, Calif., operated during a complete winter, one with and one without glycol vaporization. A careful record kept of absenteeism showed that the absenteeism in the plant employing vaporization was exactly half that in the plant where no such control was introduced.

Steam Cooker Relined with Stainless Steel

The large steam jacketed cooker shown in the illustration had become badly rusted and was causing considerable trouble by discoloring the contents. Contamination of the cooked materials was eliminated by installing a 16-gage stainless steel lining with electric arc welding and stainless steel electrodes.

To insure a minimum loss of heat transfer, the lining was installed in 12-inch strips and tightly expanded against the inner face of the tank by two ¼-inch steel bands equipped with turnbuckles. Use of the steel bands clamped the 12-inch strips snugly to the wall of the cooker and at the same time held them in place during the welding of the joints. As each strip was installed it was bonded to the inside of the tank by welding along the edges with ⅛-inch stainless steel electrodes. Each successive strip was installed in this manner and any open spaces at the seams were completely filled in with stainless steel electrodes.

This unit has been back in service for quite some time and with very satisfactory results, the contamination having been completely eliminated. While the heat transfer rate has been decreased by approximately 20%, this has not seriously hampered the particular process and we are still using the same steam pressure in this cooker as before.

—Randolph Mockbee.

Two adjustable expanding bands hold strips of stainless steel in place while the author welds each seam. Data and photo from the Hobart Brothers Co. Arc Welding News Contest.

HEAT AND VENTILATION

in the

DESIGN OF DAIRY STABLES

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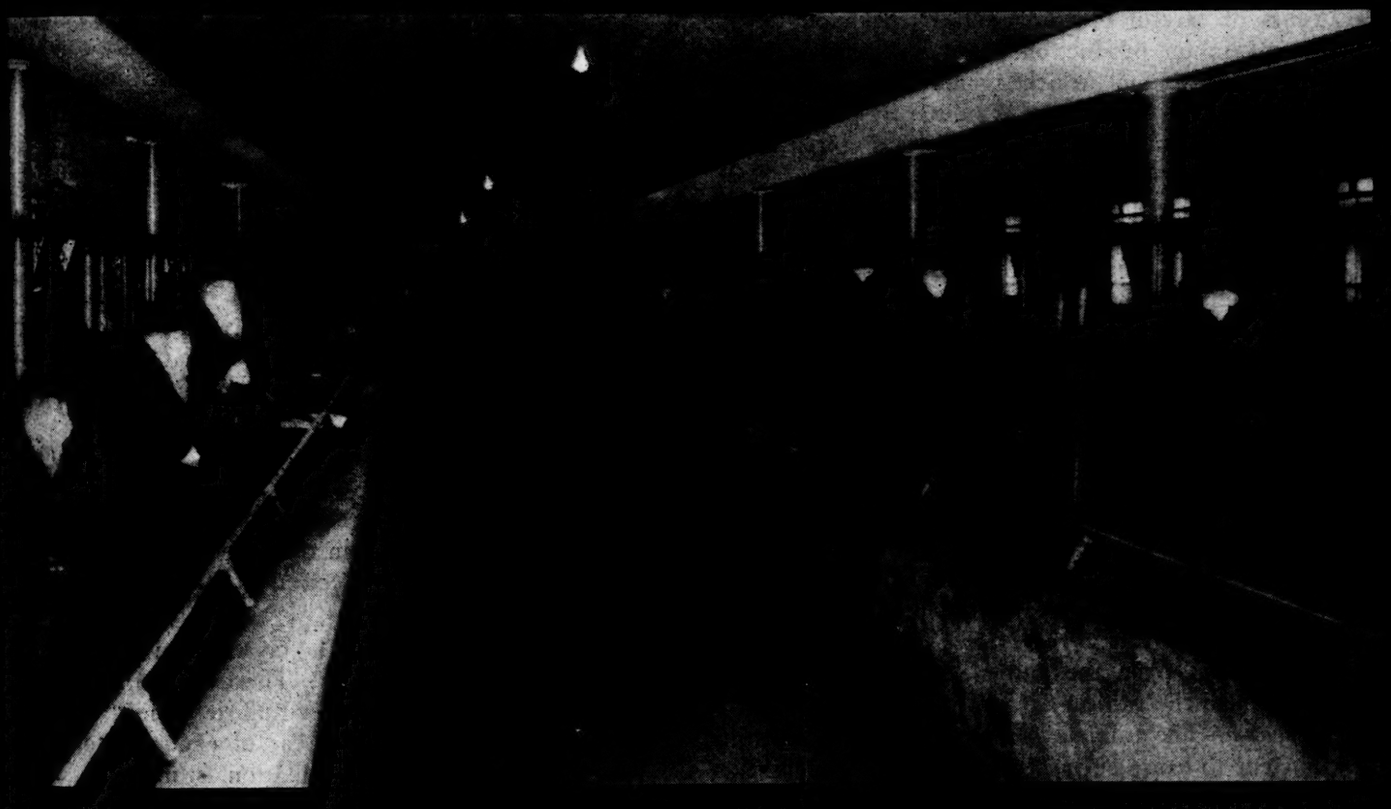


HEATING AND VENTILATING'S REFERENCE SECTION

Heat and Ventilation in the Design of Dairy Stables

J. L. STRAHAN

Agricultural Engineer
The Flintkote Company
New York, N. Y.

The engineer confronted with the design of dairy stables must know about the cow, not as a milk producer, but as a heating plant. As a moisture producer, too, she is in a very real sense a piece of air conditioning apparatus. Mr. Strahan tells how to design a dairy stable so that heat and moisture can be kept in balance in any climate, with proper insulation and ventilation.

ONE of the most important agricultural enterprises in America centers around the dairy cow. As a producer of human food, she is pre-eminent. Years of careful breeding and research on feeding for maximum production have developed a highly specialized animal which is more than ordinarily sensitive to environmental temperature changes. Today many dairymen are agreed that a reasonable degree of control over stable temperatures in both cold and hot weather is essential to maximum biological efficiency; i.e. to the most economical returns in the milk pail from properly balanced feed rations. Since the industry is widely distributed geographically and therefore subject to a wide variety of climatic conditions, the design of heating and ventilating for animal housing poses a very real though somewhat unusual engineering problem.

Fundamentally, physical principles are involved in much the same way as in any other heating and ventilating problem. A rational solution is possible but there are certain peculiarities which must be considered before it can be developed.

First—Empirical, cut and try practices over the last twenty or thirty years have demonstrated that natural heat from the animals is adequate for the job even in the coldest areas.

Second—The animals produce moisture in amounts sufficient to cause serious trouble from condensation when stables are built so tightly that air leakage is cut to a relatively small amount.

Historically the situation has evolved about as follows. In the early days stables were constructed as a rough protection against the extremes of a rigorous climate. Doors, windows, and relatively loose wall construction provided all the leakage necessary for what was then considered proper ventilation. But inside stable temperatures fluctuated through a wide range during the winter months. Later, better livestock demanded better protection whereupon the stables were tightened up against air leakage. Immediately the moisture problem was intensified, and attempts to solve it through controlled ventilation were only partially successful. It was apparent that nothing much in the way of temperature control had been accomplished by simply substituting controlled for uncontrolled ventilation. An acceptable solution was reached only after stables were adequately insulated, thereby making possible the retention of sensible, natural heat in sufficient quantities to allow removal of excess moisture in vapor form without permitting rapid temperature changes.

Basically, the problem is one of heat balance, Heat produced by the livestock is all dissipated by a combination of ventilation and radiation and conduction. The concept can be expressed by a formula which states that

$$H = V + R \quad \ldots\ldots (1)$$

where

H = heat produced per hour by the stock
V = heat lost from the stable by ventilation
R = heat lost by conduction and radiation.

Assuming that H is constant, as the value of R is reduced by compact stable layout and insulation, the value of V is increased. The question is simply one of determining whether sufficient heat can be saved by minimizing the areas of exposure to heat loss, and by the use of insulation, storm sash and storm doors, to do a job of heating and ventilating without going outside the bounds of good construction economy.

Before a start can be made in this direction, it is necessary that the engineer take a look at the cow. He must consider her, not as a milk producer, but as a heating plant. As a moisture producer, too, she is in a very real sense a piece of air conditioning apparatus. She is at once the cause of the problem and the solution to it. How much heat and how much moisture does she produce?

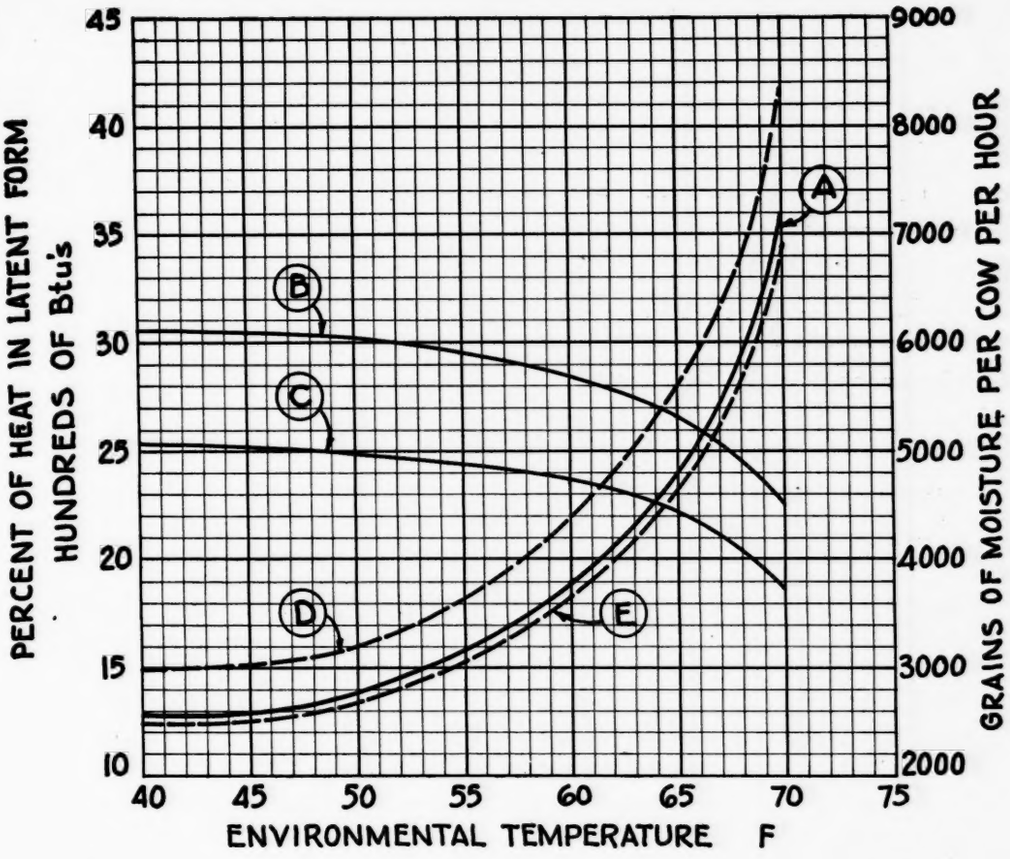


Fig. 1. Heat and moisture production by large and small cows. Curve A—variation in % of latent heat with outside temperature changes. Curves B and C—variation in sensible heat production by large and small cows. Curves D and E—variation in moisture production by large and small cows.

BASIC DATA

In 1921 Dr. Armsby, of Pennsylvania State College, at the request of a committee on animal shelter ventilation of the American Society of Agricultural Engineers, presented a method of computing the heat production of dairy cows based upon a formula involving the calorimetric determination of fasting katabolism, to which he added heat increments due to different feed rations, of which the thermal characteristics of the components had previously been determined. He tabulated the total heat and moisture production for various categories of dairy animals as follows:

TABLE 1.—HEAT AND MOISTURE PRODUCTION BY DAIRY COWS

	Total Heat Calories/Day	Moisture Grams/Day
900 lb Jersey producing 20 lb of milk per day	16,313	6,947
900 lb Jersey producing 30 lb of milk per day	18,273	7,782
1,250 lb Holstein producing 30 lb of milk per day	19,905	8,477
1,250 lb Holstein producing 45 lb of milk per day	22,372	9,528

The values for heat are based upon a fasting katabolism of 6,000 calories per day per 1,000 lb of live weight (determined directly in the animal calorimeter) to which has been added heat increments derived from rations which are typical for animals producing on the stated levels. The values for moisture are based on the assumption that 25% of the total heat is in latent form, i.e. utilized to evaporate water from the lungs and the body surface.

While these data are very significant, they do not themselves present an immediate basis for rational design. Cows are warm blooded animals, which means that they must maintain a uniform body temperature regardless of wide fluctuations in environmental temperature. They do this by virtue of a very sensitive thermo-regulatory process which involves the interaction of a number of different biological mechanisms, one of which results in varying the amount of moisture evaporated from the body when environmental temperature changes. Thus in warm weather the respiration rate increases. In cold weather it decreases. While they do not have a highly developed system of sweat glands, as do men and horses, there is some increase in body surface evaporation in warm weather which helps to maintain the essential temperature within the body. Thus in warm weather there is a decrease in heat radiated from the body (sensible heat) accompanied by an increase in moisture evaporation (latent heat).

Since the object of good stable design is to eliminate all moisture by means of ventilation before it condenses, the only heat that can be considered available to do the heating and ventilating job is that part of the total that is in sensible form. Therefore, it is desirable to know how this amount varies with environmental temperature. Only then can appropriate values be selected for design purposes.

As a by-product of later researches into livestock nutrition and metabolism some data bearing on this subject have been made available. The Curve *A* in Fig. 1 indicates, with a degree of accuracy sufficient

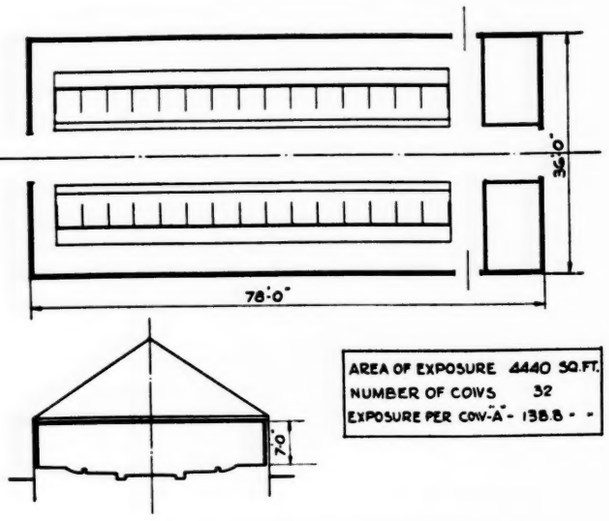


Fig. 2A. Layout and section of 32-cow barn.

for stable design purposes, the way the percentage of latent heat varies with environmental changes.

It is to be noted that within the range of temperatures usually occurring in dairy stables, this variation is from about 16% to as much as 35%, more than double.

PRACTICAL CONSIDERATIONS

For the present purpose it is reasonable to assume that the total amount of heat produced by the animals is constant. This is so in spite of the fact that it varies as between breeds, size of animal and the "plane of nutrition," the latter being roughly reflected in the amount of milk produced. What we are looking for here is a *design factor,* not a precise statement that must be laboriously determined for every cow in the herd that is to be housed. It is sufficient to strike an average that will be generally true within reasonable operating limits. One average might well be set for large cows and one for small ones because different breeds can be placed in categories with respect to size. Then a stable designed on these bases will perform better or worse depending upon the heat producing capacity of the animals at any given time. It is analogous to the effectiveness of an internal combustion engine when powered with good or poor fuel.

Armsby's figures, quoted above in Table 1, have been used to derive two heat production factors. The two small cow values and the two large cow values have been averaged separately and converted to Btu's produced per hour, setting the value at the nearest 100 Btu. Thus—

TABLE 2.—HEAT PRODUCTION BY DAIRY COWS

	BTU PER HR
Small cows	2,900
Large cows	3,500

Sensible Heat Available

These values have been used to compute the amount of heat that will be available per animal unit under any given environmental temperature. Curve *A*, Fig. 1, indicates that at a temperature of 50F, 13.85% of the heat is in latent form. 86.15%, therefore, will be sensible. 86.15% of 3,500 Btu = 3,015. Similar computations for other temperatures produced the data from which Curve *B* was plotted. Curve *C* was derived in the same manner but 2,900 Btu was used instead of 3,500.

Moisture Produced

Since the latent heat of one gram of water vapor is 2.32 Btu, the number of grams of water vaporized can be determined by dividing this figure into the amount of latent heat produced by the animals.

At an environmental temperature of 50F, 13.85% of the total heat is in latent form. As the total heat for large cows is 3,500 Btu, the latent heat will be $3500 \times 0.1485 = 485$ Btu, and the amount of water vaporized will be $485 \div 2.32 = 209.0$ grams. This amounts to $209.0 \times 15.432 = 3{,}225$ grains per hour per cow. A similar computation for other temperatures produced the data from which Curve *D* was plotted. Curve E was plotted from data derived in a similar manner for small cows.

In order to obtain basic design data for a dairy stable from these curves, it is necessary only to decide upon the inside temperature to be maintained and select heat and moisture values appropriate to this temperature.

DESIGN PROCEDURES

Adequate performance of a stable in use requires that a proper adjustment be made between all those elements of the problem which are significant with respect to temperature control. These are:

(1.) The cow, which produces both the moisture to be removed and the heat necessary to remove it,

(2.) The climate, or temperature difference which determines the rate of heat loss by conduction,

(3.) The building itself, whose size, shape, and insulation characteristics also limit the amount of heat loss, and,

(4.) The ventilation system, which together with infiltration through the construction, determines the rate of heat loss by air change.

The relationship between these various factors can be precisely expressed by means of an elaboration of the basic heat balance formula, in which all values are reduced to a per animal basis, as follows:

$$H = \frac{VD}{53} + ACD \qquad (2)$$

in which

H = Sensible heat in Btu per hr per cow

V = Air change in cfh per cow
53 = Volume of air raised 1F by 1 Btu at stable temperatures (50 to 60F)
A = Area of exposure to heat loss in square feet per cow
C = Average weighted heat transmission coefficient through walls, ceiling, windows, doors, etc. (average "U" value)
D = Difference in temperature between inside and outside.

Briefly,

H = Heat produced per cow per hr

$\frac{VD}{53}$ = Heat lost by air change per cow per hr

ACD = Heat lost by radiation and conduction per cow per hr.

It will be apparent that the value of A × C is a function of the design of the building. A large stable housing few cows will have a relatively large value for *A*. If there is little or no insulation in the construction the value of *C* will also be relatively large. Conversely, these values will be small when the stable is laid out in such a manner as to accommodate the greatest possible animal population and when ample insulation is used in the construction. As it is desirable in cold climates to provide for as much heat as possible, the latter design situation is generally preferred, for in this case the greatest amount of heat is available and the least amount is lost.

A transformation of the heat balance formula can be made which states the value of AC in terms of the other factors. Thus,

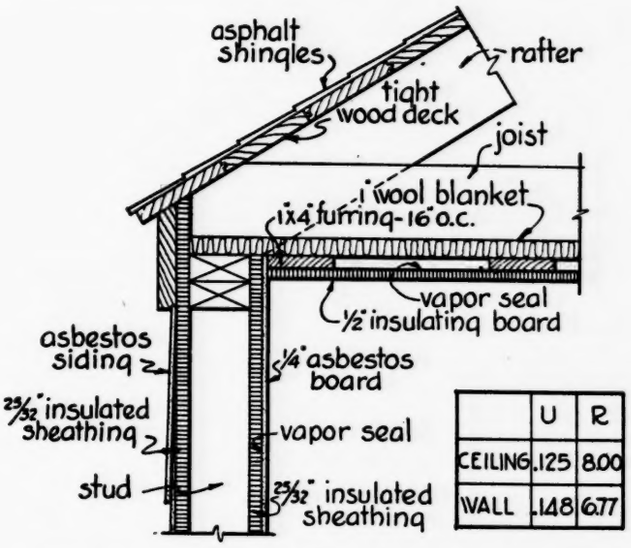
$$AC = \frac{H}{D} - \frac{V}{53} \quad \text{.....(3)}$$

By the use of this formula a value can be derived that will indicate the thermal characteristics of the building design for any given climatic situation, providing the rate of air change *V* is first computed. And this raises the whole question of ventilation.

VENTILATION

It was originally held that a minimum standard of air purity was essential for the health of the stock. F. H. King, early in the century, proposed a standard based upon lung capacity, and rate of respiration which could be measured in terms of CO_2 content of the stable air. Briefly it postulated that not over 3.3% of the air in the stable should have been once breathed at any time. This would limit CO_2 to about 17 parts per 10,000, assuming incoming air to contain from three to four parts, and required that approximately 3,500 cfh per cow pass through the stable continuously.

This is found both in theory and practice to be incompatible with the control of stable temperature



	U	R
CEILING	.125	8.00
WALL	.148	6.77

Fig. 2B. A design to protect dairy cows against a temperature difference of 70°F in which it is possible to hold inside temperature to a minimum of 50°F and relative humidity to 75% without danger of surface condensation.

which is, in fact, the practical criterion of good performance. It is now felt that varying air flow as a means of regulating temperature is to be preferred to maintaining constant air flow in order to regulate air purity, so long as this can be done without causing humidity to rise to the dew point of interior wall surfaces. The question now is not how much air change is needed to hold CO_2 to 17 parts per 10,000, but rather to what extent can air change be restricted without causing condensation.

A simple computation can be made to determine this minimum allowable volume of air change once the design conditions of temperature difference and maximum permissible relative humidity are set up.

Example

Assume the temperature difference (value of D) to be 70F and the maximum allowable R.H. to be 75%. Then minimum allowable volume of air change will be

$$V = \frac{W}{w} \times M \quad \text{.....(4)}$$

when W = grains of moisture produced per cow per hr.

w = difference between the grains of moisture per lb in outgoing air at assumed environmental temperature (60F) and R.H. (75%), and the grains of moisture per lb of incoming air at outside temperature (— 20F) and 100% R.H. (Psychrometric tables—ASHVE Guide 1945).

M = cu ft per lb of air at specified T and R.H. (inside conditions).

Referring to Fig. 1 it will be observed that large cows will produce 3,200 grains of water vapor at 50F. Substituting this in the above formula (4)

the value of V under restricted conditions can be derived.

$$V = \frac{3{,}200}{38.2} \times 12.95 = 1{,}084.8.$$

It appears that under the most unfavorable weather conditions it will require 1,084.8 cfh per cow to hold R.H. down to 75% when outside temperature drops to —20F and inside temperature remains at 50F. It remains to determine the thermal characteristics (AC) of a stable in which this can be done safely and still avoid condensation.

Referring to formula (3) a substitution for all factors is now possible. Thus,

$$AC = \frac{3{,}015}{70} - \frac{1{,}085}{53} = 22.6$$

Typical Layout

Consider now a typical stable layout as shown in Fig. 2A having 2 rows of 15 cows each and 2 pens. It will house 32 units. The total area of all walls and the ceiling divided by 32 in this case equals 138.8 sq ft. This is the area of exposure per cow and is designated by the term *A* in the heat balance formula. The value of *AC* for the stated climatic conditions is shown to be 22.6. The value of *C* will therefore be 22.6/138.8 = 0.1628.

The average rate at which heat can be lost from this stable per square foot per degree of temperature difference per hour is 0.1628 Btu. This furnishes a guide to the design of insulation, the use of storm sash, construction of doors, etc. To accomplish this requires an analysis of the plan to break it down into its major elements as follows:

TABLE 3.—ANALYSIS OF INSULATED STABLE DESIGN

Unit	Area	U	R	Heat Loss
Side Walls	1,382	.16	6.25	221.12
Windows	96	.45	2.22	43.20
Doors	154	.37	2.70	56.98
Ceiling	2,808	.14	7.14	393.12
Totals	4,440			714.42

The total area of exposure is 4,440 square feet. Therefore the total allowable heat loss from the stable under the design conditions will be 4,440 × .1628 = 716.3 Btu, per degree per hr.

Assuming that storm sash will be used the *U* value for windows will be .45. The *U* value for double thickness wood door will be .37. The *U* value for walls must be somewhere near or lower than the average (value of *C*). It can be set at .16 as a trial. By computing the losses through the first three elements of the construction and adding them it will be possible, by subtracting this sum (321.3) from the total allowable loss (716.3), to obtain the amount that can be lost through the ceiling. Thus,

$$716.3 - 321.3 = 395.0.$$

As there are 2,808 sq ft in the ceiling the value of *U* for this element will be

$$\frac{395.0}{2{,}808} = .1406.$$

It remains now to design a wall with *U* value of .16 and a ceiling with a *U* value of .14 in order to protect the stock against a temperature difference of 70F without permitting R.H. to go above 75% or the stable temperature to fall below 50F. Any combination of appropriate materials which will meet these thermal requirements will do the job.

Fig. 2B indicates construction which is somewhat better than this but is probably as close to the requirements as can be reached economically with the type of materials commercially available.

PERFORMANCE

Design procedure to this point has determined the rate of air change required to maintain an assumed maximum allowable relative humidity. It has determined the thermal characteristics of walls and ceilings required to conserve sufficient heat to maintain an assumed maximum temperature difference. But it remains to be shown whether the resulting wall and ceiling construction will resist moisture condensation under the assumed conditions. It remains also to be determined the maximum capacity of a ventilating system that will provide not only for restricted air flow under cold conditions but also for maximum air flow under comparatively warm conditions. To accomplish this it is now necessary to inquire into the performance of the design under variable weather conditions, i.e. outside temperatures ranging from 30F above zero to 30F below.

Variable Air Flow

In Fig. 3 Curve *A* indicates how air change must vary with outside temperature in order to maintain an inside temperature of 50F. At —30F it must be restricted to 800 cfh per cow. At + 30F it must be increased to 6,800 cfh per cow. The curve leaves the chart at 6,000 cfh per cow at an outside temperature of 28F. At —20F, the assumed design condition, the rate is 1,085 cfh.

This curve is computed by means of a second algebraic transformation of the heat balance formula (2) which states that

$$V = \frac{53\,(H - ACD)}{D} \qquad (5)$$

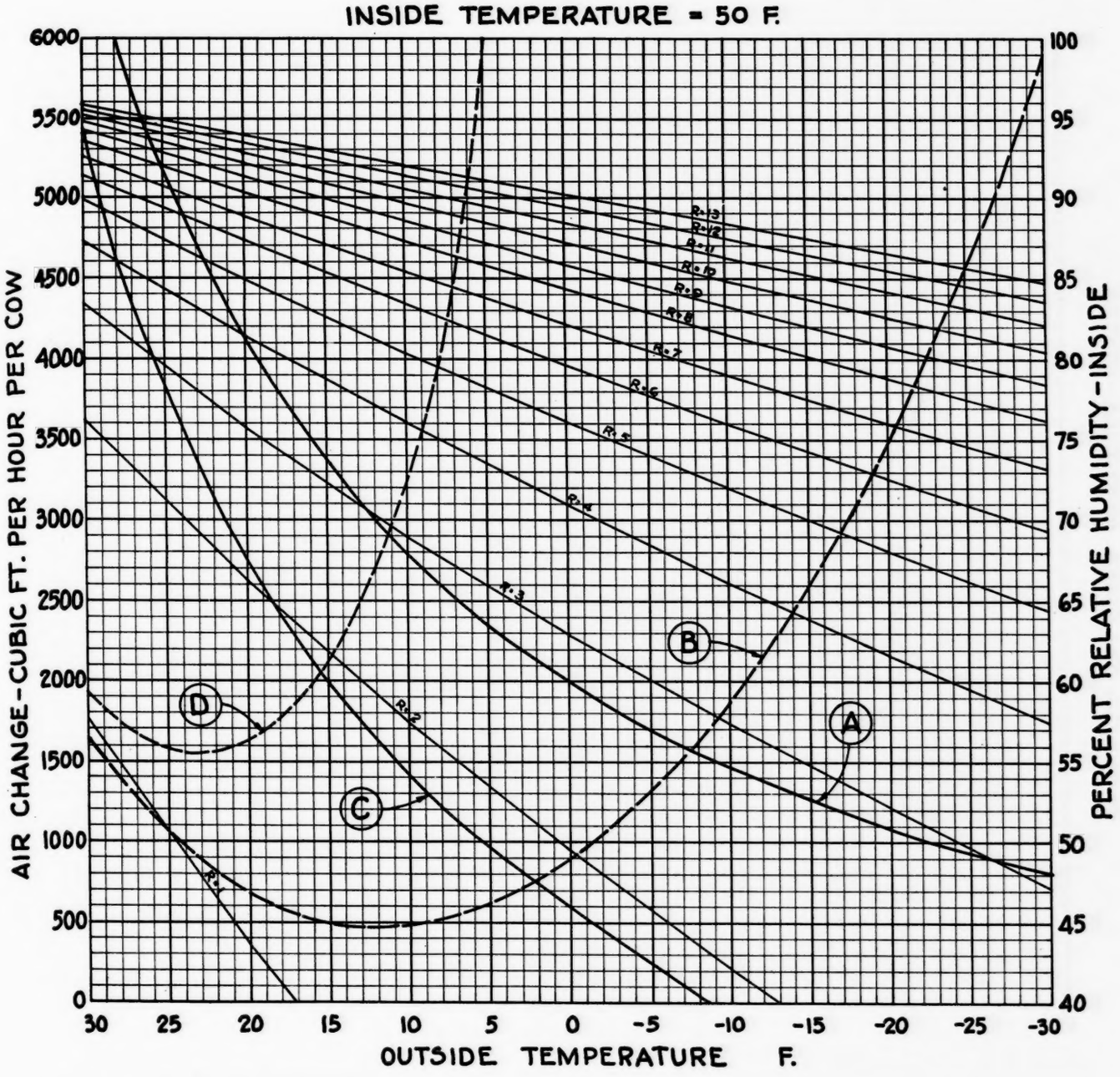


Fig. 3. Stable performance with respect to temperature and humidity control. Curves A and C—variation in rate of air change through an insulated and an uninsulated stable. Curves B and D—variation in relative humidity in an insulated and an uninsulated stable.

A point for each 5F outside temperature line is computed by substituting values for H (3,015 Btu), AC (22.6) and the appropriate temperature difference. A sample computation for an outside temperature of zero follows:

$$V = \frac{53\ (3{,}015 - [22.6 \times 50])}{50} = 1{,}998.$$

Ventilation Capacity

It is to be observed that if inside temperature is to be kept down to 50F when outside temperature rises to around 30F a marked increase in air flow must take place. The indicated rate will require more fan capacity than is usually provided in practice, the alternative being to permit inside temperature to rise to between 55 and 60F. If outside temperature continues to rise it is customary to open windows and doors and make no further attempt to control ventilation. The present apparent economic limit for maximum ventilation capacity is between 5,000 and 6,000 cfh per cow, but it is important to realize that tight, well insulated stables do not permit of air leakage in amounts anywhere near sufficient to provide significant help to the ventilation system in warm weather. It is very essential that the stable attendant resort to manual operation of doors and

windows when temperatures outdoors range upward from freezing.

Curve *B* (Fig. 3) indicates how relative humidity varies as air flow changes to compensate for increased temperature differences. During the early stages of a temperature drop, relative humidity decreases in spite of a sharp restriction of air flow, because the moisture carrying capacity of incoming air increases, due to raising it to barn temperature, an amount out of proportion to its reduced volume. A point is reached, however, about 13F above zero outside when further restriction of ventilating will cause relative humidity to rise rapidly until at —30F it is up very close to saturation. At —20F it is at 75%, as required by the design.

Relative Humidity

The R.H. curve is computed on the assumption that inside temperature remains constant at 50F, that moisture production remains constant at 3,200 grains per cow per hour, and that incoming air is at the saturation point for outside temperature.

A series of diagonal lines have been drawn across the chart marked R = 1 to R = 13. These represent resistance to heat flow (reciprocal of *U*) and indicate, for each outside temperature, the relative humidity of inside air at which condensation will occur on an inside surface. For instance, if an element of the building has a resistance of 4, condensation will occur on its inside surface at —15F (outside) when R.H. rises to 64%. It is to be observed that for this design the relative humidity curve crosses the R = 4 line at an outside temperature of —14F which indicates this to be the point at which condensation will appear on the surface of any element of the structure having a resistance of 4. If the construction has a resistance of 6 it will prevent condensation until outside temperature drops to —19F. In this design the resistance of the wall is $\frac{1}{.16} = 6.25$ and that of the ceiling is $\frac{1}{.142} = 7.04$. In the first instance condensation will occur at —19½F and in the second at —20½F. This is close enough to the design conditions as set up (—20F) for all practical purposes.

Uninsulated Design

Curves *C* and *D* have been added to the chart to indicate the performance to be expected from a stable built without insulation, assuming that an attempt is made in cold weather to hold the temperature to a comfortable point by restricting air flow. This is a very common practice among dairymen in northern areas who want to keep construction cost down and has been the cause of much building depreciation through condensation. The layout and shape of the building is the same as shown in Fig. 2A except that no insulation is used. A thermal analysis of the design is tabulated as follows:

TABLE 4.—ANALYSIS OF UNINSULATED STABLE DESIGN

Unit	Area	U	R	Btu Loss
Side Walls	1,382	.39	2.58	538.98
Windows	96	1.1	.98	105.60
Doors	154	.57	1.76	87.78
Ceiling	2,808	.29	3.45	814.32
Totals	4,440			1,546.68

$$A = \frac{4,440}{32} = 138.8$$

$$C = \frac{1,546.68}{4,440} = .3483$$

$$AC = 138.8 \times .3483 = 48.3.$$

If ventilation is restricted in this stable to 1,085 cfh per cow, which was the maximum allowable restriction in the insulated stable, the maximum temperature difference attainable will be only 42F, outside temperature being then at 8F above zero. At this point, however, R.H. will have increased to about 80% and would require a thermal resistance in the construction to be over 5 if condensation is to be prevented. As the wall construction has a resistance of only 2.58 and ceiling of 3.45 it is evident that condensation will be severe. The limit for the wall will be reached at an outside temperature of approximately + 12½F and that for the ceiling at + 10F. To be safe for both elements of the construction, ventilation cannot be restricted below about 1,700 cfh per cow. The design will be adequate, therefore, only in a climate where the temperature difference will not exceed about 38F which limits its use to areas well below the Mason and Dixon line.

Conclusion

The design method outlined here furnishes a rational basis for adapting insulation and ventilation recommendations to various climatic conditions. The value of AC is the factor that must first be determined once the conditions under which the stable is to function are established. The colder the climate, the lower must be the value of this factor. With AC as an index, the amount of insulation required, the capacity of the ventilation system, and the climatic range in which the structure will safely function can be readily determined.

Air Fills the Bag

WM. B. FOXHALL
Assistant Editor
HEATING AND VENTILATING

CONTROLLED air was the answer in one plant to the problem of packaging powdered asbestos.

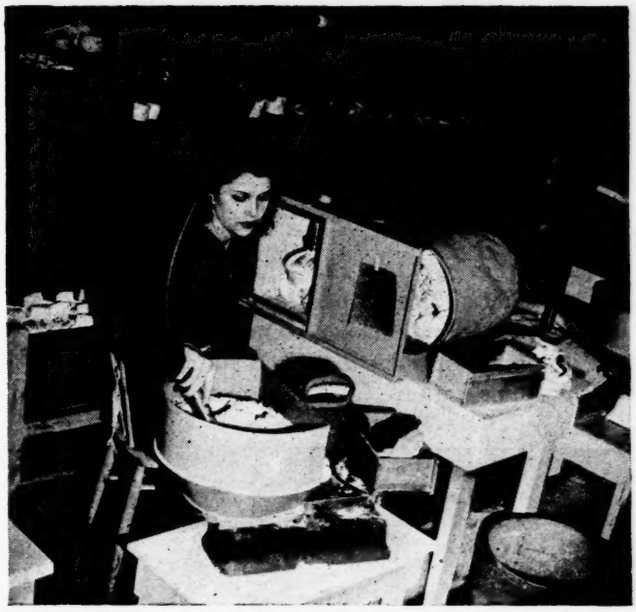
Arthur A. Gardner put the research department of Breslee Mfg. Co. to work on the problem of filling thousands of cotton bags with asbestos for dummy propelling charges required by the Army for practice firing of the 105-mm howitzer. The problem was complicated in several ways. First, each charge consists of seven bags loaded to specified weights ranging from 1.7 oz to 13.1 oz. Second, the tackiness of the asbestos made hand weighing difficult and prevented the use of gravity feed machines. Third, the dust of powdered asbestos is a health hazard.

Mr. Gardner's engineers designed an assembly line of seven filling machines piped into a master vacuum system which both filled and weighed the bags by air.

The operation of filling the bag takes place within an air-tight box opened on one side by a sliding door, the frame of which is lined with sponge rubber to make an air-tight seal when the door is closed.

The operator clamps the empty bag to a nozzle suspended from the top of the box. This nozzle connects outside the box to a flexible transparent plastic tube about 4 ft long. The open end of the tube is used by the operator in picking up asbestos from a hopper resting on one side of a scale. The other side of the scale carries several small metal plates, the total weight of which perfectly balances the asbestos in the hopper. Each plate represents the exact weight of one filled bag.

With the scale in perfect balance, the operator removes a single metal plate, throwing the scale off balance the exact amount necessary to fill one bag.

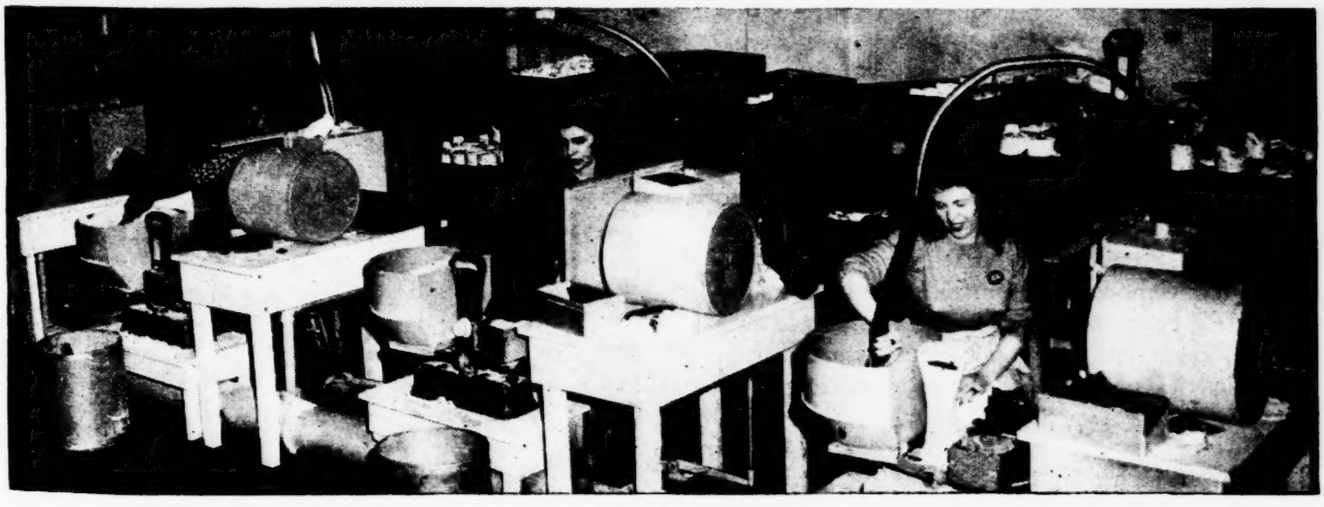


Showing scale arrangement and open door of vacuum box containing bag clamped to end of saran plastic tube.

She then inserts the mouth of the tube into the hopper and steps on a treadle to open a valve connecting the tube and fill-box to a vacuum system. Asbestos is drawn from the hopper and deposited in the bag. As soon as the scale returns to balance, the operator closes the valve and the flow of asbestos stops immediately.

Breslee engineers estimated that their vacuum filling system required 450 cfm through the tube. They installed a Spencer turbine blower powered by a 7½ hp motor at 3500 rpm, which maintained the required vacuum with a volume of 600 cfm, more than sufficient for the proper functioning of the system.

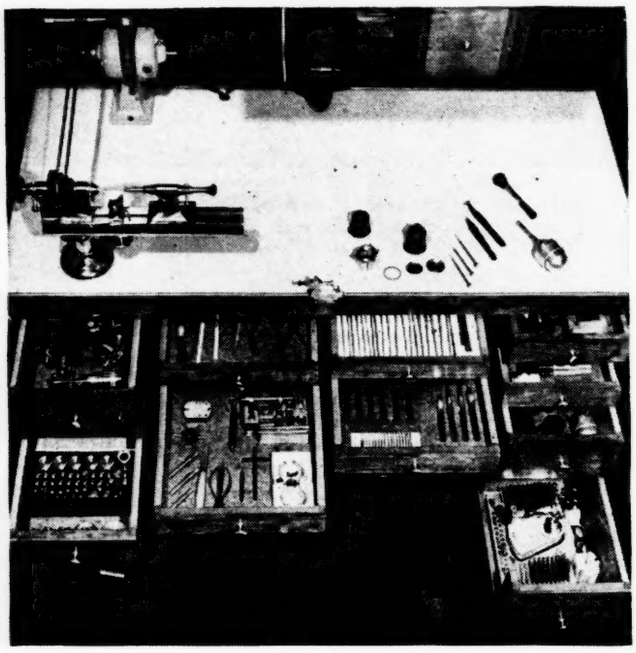
This vacuum method of precision filling resulted not only in extreme accuracy but also in about 600% increase in production over hand weighing and filling. Still more important, however, was the elimination of the hazard to health represented by the manual handling of the finely powdered asbestos.



Part of packaging assembly line. Hoppers of asbestos on scales balance boxes of measured weights. As weights are removed one by one, asbestos is vacuum drawn out of hopper into cotton bag through flexible transparent tube to return scale to balance. Foot treadle controls vacuum.

Veterans Learn Watchmaking in an Air Conditioned School

REHABILITATION and training of disabled veterans is being undertaken by the Bulova School of Watchmaking in a modern 2-story air conditioned building for a limited number who can meet the qualifications for enrollment. The school, adjacent to the Bulova Watch Company plant in Woodside, Long Island, is completely air conditioned not only to provide comfort, but to maintain controlled humidity so that delicate watch parts and tools will not be damaged by excess moisture on the hands.



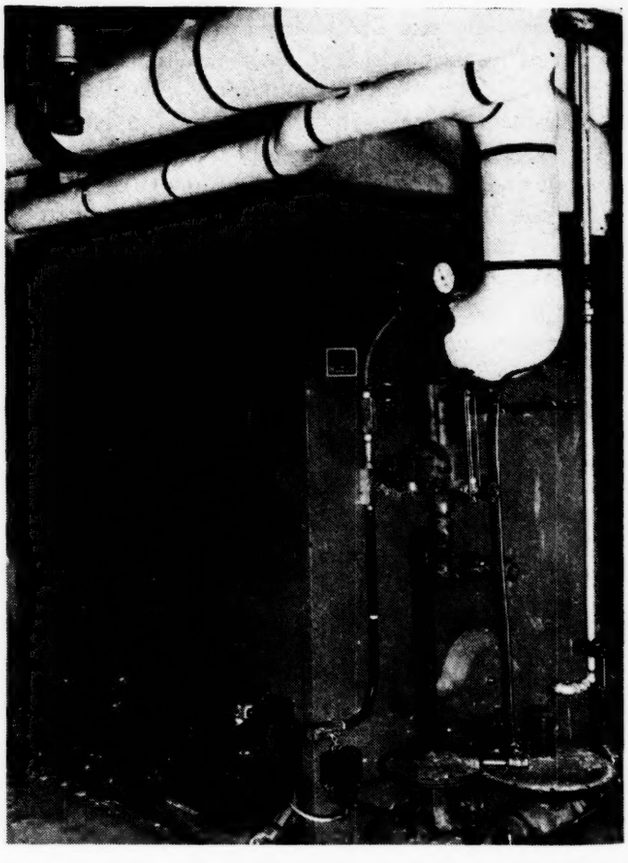
Air conditioning helps preserve delicate instruments at student's bench.

An air conditioning plant is in operation which maintains a level percentage of humidity the year 'round. One feature of the system is the gas fired steam boiler which supplies steam to the fin type radiators located in all the ventilating ports. In summer refrigerated dehumidified air of comfortable temperature is supplied, and in winter the circulating air, which has been brought up to a predetermined percentage of humidity, is heated. Each room has its individual temperature control. Overall humidity is accurately controlled in the central plant. Steam from the gas fired boiler plays an essential part in keeping the proper balance of conditioned air throughout the year.

Many things have been done for the comfort of the veteran students in addition to the accurately controlled gas heated conditioned air. Electric eye door openers facilitate the passage of wheel chair cases and other physically handicapped students; ramps and an elevator make progress through the building easier. All the necessary tools to carry on the practical studies are supplied. A large library with a collection of books on horology and other subjects of interest to the students is under the supervision of a trained librarian.

The school is chartered by the New York State Board of Regents, and the Trustees are limiting enrollment to veterans of World War II who are disabled to the extent that they receive a certain minimum Government pension. This training of disabled veterans is being carried on without charge to the veterans and without any reimbursement from the Government. The complete cost of the school building and training program has been assumed by the Bulova Watch Company.

Arrangements have been made with three veterans' hospitals where the students, who have been enrolled after special aptitude tests, may receive preliminary training up to the time of discharge from the hospital before entering the school. Already 14 veterans at the Walter Reed Hospital, Washington, D. C., are receiving instructions from a member of the faculty sent to the hospital for that purpose.



Bryant tubular gas-fired boiler operates automatically as part of summer-winter air conditioning.

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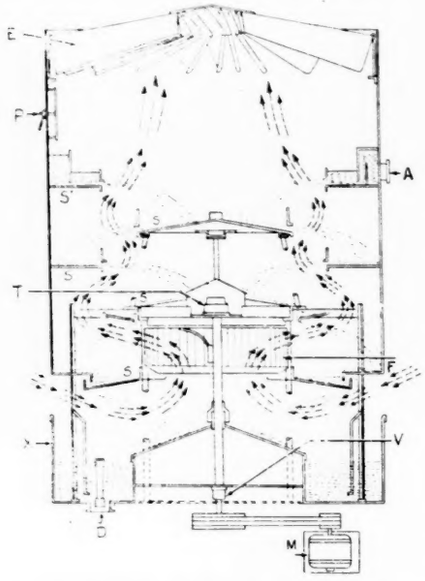
NEWS OF EQUIPMENT AND MATERIALS

Coey Cooling Tower

NAME—Coey floating film cooling tower.

PURPOSE—For use wherever water is used commercially or industrially as a coolant.

METHOD OF OPERATION—Device, cylindrical in appearance, operates on floating film principle whereby water pouring in a film from a series of shelves is met by a counterflow of air flowing at 1500 feet per minute. Force of air causes stream of air to break into droplets substantially all



the same size, size being important because when droplets are too large they are not cooled enough and when too small they evaporate completely. Air is guided upward through tower in a slightly horizontal direction due to interior design. In drawing, motor *M* drives centrifugal fan *F* mounted on a heavy-duty thrust bearing *T* and a pilot bearing *V*. Air inlet is at bottom. Air flow, as shown by arrowed lines through continuous opening around lower periphery, flows through fan and upward and out spray eliminator *E*. Water admitted at inlet *A* to continuous circular shelf *S* then drops into other shelves or stages as indicated by *S* following the path shown by the light dotted lines until it reaches copper-bearing steel bottom pan *X*. Cool water is discharged at *D*. An access door *P* is provided.

FEATURES—Manufacturer guarantees accurate performance of tower under design conditions. Tower is light in weight and operation is said to be quiet, showing only a few decibels rise in sound over street noises. All metal construction. Spray eliminator is so designed that accumulating water is not blown out but returned to distribution drive for re-use. Fireproof.

SIZES AND CAPACITIES—Available in four sizes with capacities ranging from 100 to 1500 gallons per minute, or 75 to 500 tons of refrigerant. A

unit for 3 to 5 ton loads is in process of design.

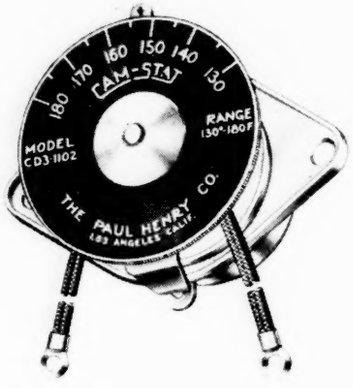
MADE BY—*Rogers Diesel and Aircraft Corp., 1120 Liggett Ave., New York, N. Y., under license by Research Corporation, New York, N. Y.*

Temperature Control

NAME—Cam-Stat temperature control.

PURPOSE—Temperature control of water heaters.

FEATURES—Tamperproof dial instal-



lation prevents changing of adjustable range provided at the factory. Unit may be clamped on the hot water tank or immersed in water. A wide variety of mounting means is available for adapting the device to the control of air, gas, liquid or solids. Company also makes the controls for ranges between —50F and 600F, with differentials as low as 1 degree.

MADE BY—*Paul Henry Co., 2037 S. La Cienga, Los Angeles 34, Calif.*

Flexible Hose

NAME—Flexible stainless steel hose.

PURPOSE—For flexible steam connec-

tions or for carrying corrosive fluids.

FEATURES—Hose is made from stainless steel tubing of various analyses. It can be used where a flexible connection is required between movable parts or where vibrations are set up between two rigidly held units.

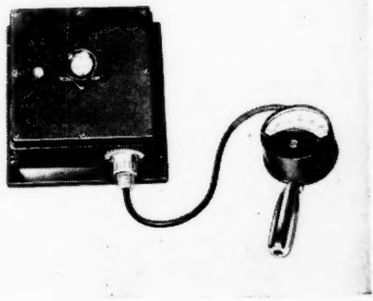
MADE BY—*The Carpenter Steel Co., Welded Alloy Tube Division, Kenilworth, N. J.*

Portable Pyrometer

NAME—Alnor portable pyrometer.

PURPOSE—Temperature measurement under severe plant operating conditions.

FEATURES—Instrument consists of a portable hand-held instrument equipped with a bayonet type attachment plug at the end of the handle. The operator plugs the pyrometer into the receptacle box which is connected permanently to the thermocouple. With the Alnor Type T selector switch (illustrated) readings can be taken from successive thermocouples in heat zones, by turning the switch knob to the thermocouple desired. The pyrometer is plugged into the switch case receptacle. One model of pyrometer has a rigid handle and



attachment plug so that when plugged into the receptacle, both hands are free for other tasks.

MADE BY—*Illinois Testing Laboratories, Inc., 490 N. LaSalle St., Chicago 10, Ill.*

Oil Filter

NAME—The Refiner.
PURPOSE—For the removal of free and emulsified oil from water, without the use of chemicals.
FEATURES—Unit consists of a series of vertical wire screen or cloth filter leaves placed parallel on a removable rack in a horizontal pressure tight cylinder. There is a mixing tank with two chambers for slurry and filtering material. Each filter element consists of two very fine screens with a central intercrimped screen. Unit may be mounted as a permanent installation or on wheels for portability. Makers claim unit will free oil from an oil content as high as 90 ppm and more, down to .01 ppm.

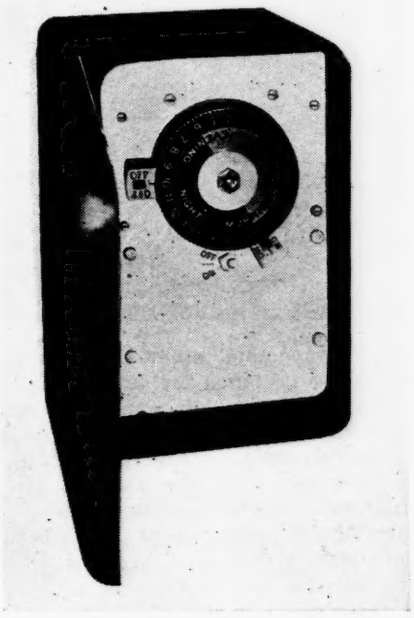
OPERATION—The type of filtering medium is first selected to suit service conditions—diatomaceous earth, asbestos, or a mixture of both in varying percentages may be used. A few minutes is required for dispersion of the filtering medium in the precoat tank. Filter leaves surfaces are precoated with the desired filter substance by recirculation. Filter medium deposits on screen to form compact, porous bed. Upon completion of the operation cycle, leaves are rolled out from the tank on movable rack. Spent filter medium is then peeled from the filter leaves.
MADE BY—*The Blackburn-Smith Mfg. Co., Inc., 95 River St., Hoboken, N. J.*

Protective Coating

NAME—Acid-causticbond.
PURPOSE—For stopping corrosion from acids and alkalies.
FEATURES—Product is a plasticized resin protective coating that can be applied by brush for air drying. Coating is also formulated for tank interiors and other submerged surfaces. It is available in several colors.
MADE BY—*The Wilbur & Williams Co., Park Square Bldg., Boston 16. Mass.*

Time Switch

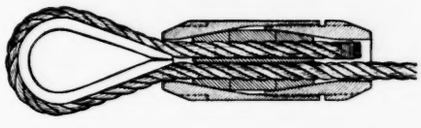
NAME—Heat-O-Meter series TS3.
PURPOSE—For the starting and stopping of stokers, oil burners, fans, blowers, pumps, motors, gas burners, and commercial lighting.
FEATURES—Except for motor and gearing, unit has only two moving parts. Switch is powered by a Telechron chart movement motor and gear train. All wires, terminals and operating mechanism are located behind the panel. When used with a twin thermostat it will shift from the day thermostat to the night thermostat, or vice versa, at the hour set. Six standard models are available and a heavy duty model is supplied on special order.



MADE BY—*Miller Heat-O-Meter Co., Milwaukee 12, Wis.*

Wire Rope Clamp

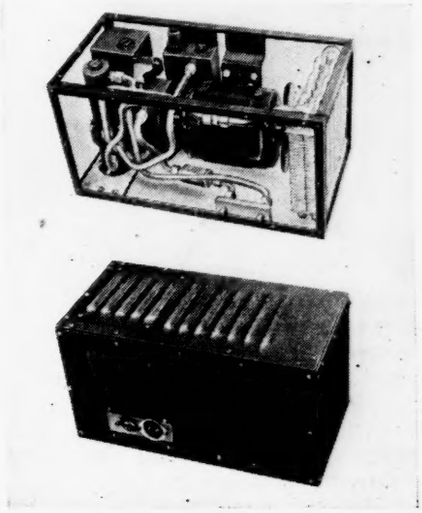
NAME—Cabl-ox.
PURPOSE—Securing wire rope.
FEATURES—Unit is alloy steel, cadmium plated for weather protection, and has two parts. Both are slipped on the rope, a loop formed with the end of the rope, and the barrel moved up over the double rope. This makes a tight loop against the thimble. The cap is now screwed into the barrel and tightened. Makers claim that the holding power of the clamp is increased as the pull is increased.



SIZES AND CAPACITIES—Made for wire rope diameters from 1/16 to 3/4 in.
MADE BY—*Nunn Mfg. Co., 2125 Dewey Ave., Evanston, Ill.*

Heat Dissipating Unit

NAME—Heat dissipating unit.
PURPOSE—For use with induction heating, X-ray tubes, and television equipment to dissipate heat.
FEATURES—Unit illustrated will dissipate 1200 watts with a constant controlled temperature, within a close heat control range of 2C. It is made in steel, bronze or aluminum and the size is 16x7½x7½ in. Other models can be built to dissipate up to 5000 watts, and units smaller than the one shown can be constructed where the wattage is much lower. Unit is furnished complete with thermostat control, thermostatic valves and flow switch.



MADE BY—*The Eastern Engineering Co., New Haven. Conn.*

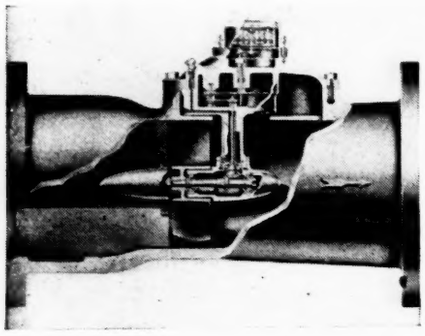
Metal Gasket

NAME—Bellowseal gasket.
PURPOSE—Better contact with metal flanges.
FEATURES—Gasket consists of two metal discs welded together around the outer periphery. Discs are machined on their external faces with standard serrations. Pressure and corrosion resistant qualities of metal gaskets are combined with the needs for a softer sealing medium. Line pressure entering gasket interior exerts expansion features in excess of the required sealing force.

MADE BY—*Goetze Gasket & Packing Co., New Brunswick, N. J.*

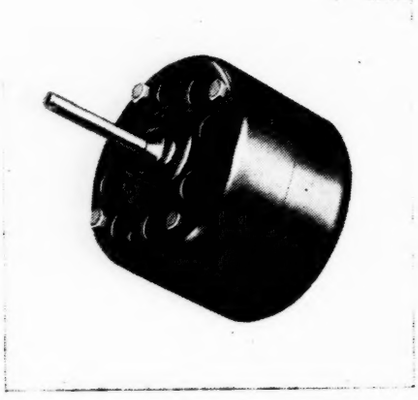
Main Line Meter

NAME—Builders Propeloflo Meter.
PURPOSE—A propeller type totalizing flow meter for main line metering.
FEATURES—Meter is installed in pipe line, as illustrated, and has an accuracy of plus or minus 2%. It subtracts reverse flow with reasonable accuracy. Meter body of venturi design creates a more uniform velocity distribution where flow meets the propeller. Register is a direct-reading six digit counter. A clear plastic bonnet protects the counter mechanism. Entire propeller unit can be removed from the line for easy inspection, when necessary.
MADE BY—*Builders-Providence, Inc., Providence 1, R. I.*



Small Motor

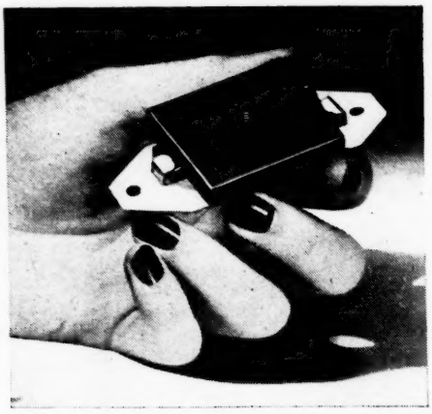
NAME—SP-37 and SP-38 fractional horsepower motor.
PURPOSE—For use with ventilating fans, blowers, centrifugal pumps, driers, unit heaters and damper controls.
FEATURES—Four-pole shaded pole motors developed for duties requiring moderate torques. They are regularly wound for 115 volts, 60 cycles, single phase although they can be wound to stand locked rotor conditions continuously. Motors have laminated fields and rotor cores.



SIZES AND CAPACITIES—SP-37 has a rating from 1/100 to 1/40 hp and speeds from 1400 to 1650 rpm. SP-38 has a rating from 1/35 to 1/10 hp and speeds from 1400 to 1650 rpm.
MADE BY—*Small Motors, Inc., 1308 Elston Ave., Chicago 22, Ill.*

Vibration Mounts

NAME—Rexon light duty vibration mounts.
PURPOSE—Elimination of vibration and noise from small motors and appliances.
FEATURES—While LH5 mounts are designed for dead weight loads as low as one pound, other light duty mounts are designed for dead weight loads up to 200 lb. Principle of this mount design combines the high vibration dampening properties of rubber in shear with the ease of installation of a compression mount.
MADE BY—*Hamilton Kent Mfg. Co., Kent, Ohio.*



Boiler Pit Waterproofing

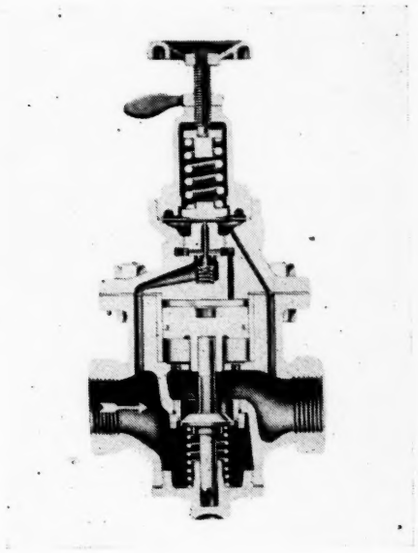
NAME—Kay Tite.
PURPOSE—For waterproofing boiler pits.
FEATURES—This material, made of a cement base, can be mixed with two parts of building sand to one part of the Kay Tite with sufficient water for thorough mixing. The boiler pit should then be made with walls and floor of from 2 to 4 inches in thickness of the foregoing mixture and the resulting pit, it is claimed, will be water tight. Available from hardware, paint stores, and lumber yards.
SIZES AND CAPACITIES—Available in 10 and 60 lb bags.
MADE BY—*Kaytite Company, West Orange, New Jersey.*

Remote Valve Control

NAME—Zurn remote valve control.
PURPOSE—For controlling valves in places difficult to reach.
FEATURES—Assembly consists of a flexible cable for transmitting torque to the handle of the valve to be operated, or a rod or pipe connected by universal joint; a remote valve control box; sleeve bushings, terminal brackets, cable clips and a rod coupling for the valve wheel. Valve control boxes are made in cast bronze, steel, semi-steel or iron.
MADE BY—*J. A. Zurn Mfg. Co., Erie, Pa.*

Air Reducing Valve

NAME—Class L-1A, air reducing valve.
PURPOSE—Developed for diesel powered ships; now field has been broadened to include most air reduction applications.
FEATURES—Plastic inserts in the valve seats are said to provide positive tight shutoff and long life. All wearing parts are removable. Valve can be overhauled without its removal from the pipe line. Valve is claimed to be stable under all flow conditions and that it will instantly respond to widest and most sudden variations in load.
SIZES AND CAPACITIES—Available in sizes ½ to 4 in. inclusive, and designed for initials pressures up to 400 lb air pressure and reduced pressures from 5 to 300 lb per sq in. Class JA-1 valve comes in ¼, ⅜ and ½ in. sizes.
MADE BY—*Leslie Co., 52 Delafield Ave., Lyndhurst, N. J.*

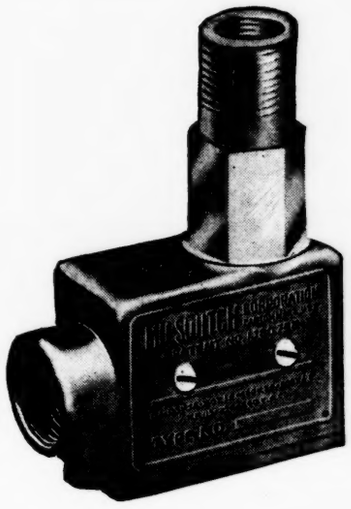


Weld Spatter Elimination

NAME—No. 9951 and 9952 weld-spatter-resistant compounds.
PURPOSE—To avoid weld-spatter.
FEATURES—Compounds come in powder form, to be mixed with water into a paste. Even if the surface of the work is slightly oily, no special wetting is required before an application. Compounds are easily mixed and can be applied with a brush. Since ingredients are inert, they are completely smokeless. No. 9951 is non-adherent and can be readily removed with an air hose or dry cloth. No. 9952 is semi-adherent but can be easily removed with a damp cloth or a direct stream of water.
MADE BY—*General Electric Co., Schenectady, N. Y.*

Pressure Control

NAME—Mu-switch.
PURPOSE—To provide an electrical control actuated by changes in fluid pressure.
FEATURES—Electrical control element is a standard single pole, double throw Mu-switch. Pressure sensitive portion consists of a metal bellows soldered into a brass tube which is securely attached to the metal housing that contains the electric circuit



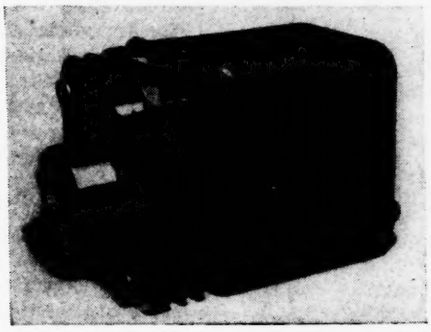
element. Upper end of the pressure chamber has a standard ½ in. pipe thread for attachment to the pressure line. Unit can be furnished for operation with a differential of 5 to 15 lb at nominal ratings of from 10 to 120 lb per sq in. Pressure chamber is made of a corrosion and heat-resisting material and the makers say it can be operated at temperatures up to 300F. Various switches are available depending on the electrical power.
MADE BY—*Mu-Switch Corp., Inc., 380 Pequoit St., Canton, Mass.*

Liquid Flux

NAME—Superior No. 30 supersafe soft solder liquid flux.
PURPOSE—To provide a fluxing medium that will not form corrosive residues.
FEATURES—Provides better wetting of the joining surfaces. Makers claim all corrosion forming residues are completely and permanently removed if the work piece is well washed after the soldering step. It may be used in soldering copper, steel, silver, brass, various alloys and some types of electroplated parts. Flux was developed by the Battelle Memorial Institute in an investigation sponsored by the Tin Research Institute.
MADE BY—*Superior Flux Co., Public Square Bldg., Cleveland 13, Ohio.*

Flame Failure Safeguard

NAME—Fireye flame-failure safeguard type F18T.
PURPOSE—Safeguard against explosion when flame fails in pulverized coal and commercial oil burners.
FEATURES—Device consists of a phototube and amplifying system housed in a dust tight aluminum case. Control is mounted on the furnace wall and is aligned to permit the photoelectric cell to observe the flame



through a 2 in. pipe connection which also serves as a support for the equipment. A clear pyrex filter keeps the equipment dust tight. Lens system has a heat absorbing filter to protect device from radiated heat. Time delay element prevents the relay from dropping out during purely transient flame disturbances.
MADE BY—*Combustion Control Corp., 77 Broadway, Cambridge 42, Mass.*

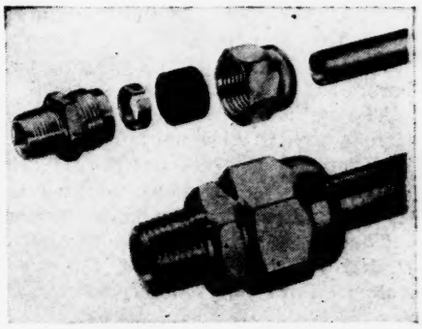
Pipe Tool

NAME—Flange-Jacks.
PURPOSE—To open pipe flanges for gasket renewal.
FEATURES—Jaws are one piece steel forgings. They are designed to open

2 to 20 in. flanges and to hold them in alignment. Makers claim jacks can open joints against a load of 15 tons without damage to the flange faces. As pressure is applied, flanges open evenly.
MADE BY—*T. G. Persson Co., 224 Glenwood Ave., Bloomfield, N. J.*

Tubing Fitting

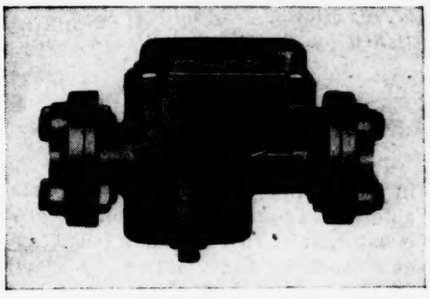
NAME—Flexigrip tubing fittings.
PURPOSE—To provide a tubing joint without the need of flaring, swedging or soldering for use in refrigeration, air conditioning, hydraulic and oil systems.
FEATURES—Unit consists of four parts—body, gripping ring, synthetic



rubber gasket and nut. To attach fitting, the nut (with the gasket and ring inside) is slipped over the plain end tube cut to desired length. Tubing end is inserted into the body as far as it will go and then the nut tightened. This compresses the ring into a tight grip on the tube and moulds the gasket into a leakproof seal. Fittings are available in brass, aluminum or steel and come in sizes from ⅛ to 1½ in. O.D.
MADE BY—*Gustin-Bacon Mfg. Co., Kansas City, Mo.*

Pump Strainers

NAME—Ezy-Kleen low swing strainers.
PURPOSE—For removing solids from pumpage before they reach the pumps.



FEATURES—Strainer area is up to 10 times greater than the pipe area. Cover is held in place by four bolts which fit in slotted lugs for quick removal. Strainer basket is exposed when the cover is removed and the basket can be easily taken out for cleaning.
SIZES AND CAPACITIES—Available for 2, 2½ and 3 in. pipe.
LITERATURE AVAILABLE—Bulletin 400 of 2 pages.
MADE BY—*Blackmer Pump Co., Grand Rapids, Mich.*

Abstracts AND Reviews

WELDED STEEL STRUCTURES

General and detailed design considerations for simple welded joints and connections and their application to typical structural members are given in this book written for designers, engineers and fabricators who use welded construction. Included are many charts to facilitate the design of welded joints and structural members.

The subject of weld geometry and stress concentration is treated at some length. One section of the book is devoted to the codes of the American Welding Society which have been widely adopted for most welded construction and form the basis for the charts and tables.

The Practical Design of Welded Steel Structures, by H. M. Priest. Cloth bound, 150 pages. Published by the American Welding Society. Price, $1.

INDUSTRY HANDBOOK

Unlike most books dealing with heating, ventilation, and air conditioning, H. P. Manly in his Heating, Cooling and Air Conditioning Handbook has succeeded in presenting his subject matter so that it will be helpful to those without an engineering background. Instead of the customary formulas, there are numbered steps to be followed. Mathematics is confined to simple arithmetic.

Charts and tables list the data required for computing heating and cooling loads, and for determining the size of equipment required. Typical examples worked out in detail illustrate the various problems encountered in practice. Included are complete instructions for the selection of pipe sizes for steam and vapor heating, and for gravity and forced circulation hot water systems.

The material is divided into 27 chapters and covers such subjects as heat transfer, evaporation and relative humidity, heating and cooling loads, ventilation, heating load calculation, types of heating systems, radiators and piping, cooling, air circulation and flow, filters, fans, burners, stokers, and automatic controls.

Heating, Cooling and Air Conditioning Handbook by H. P. Manly. Cloth cover, 5 x 7½ in., 706 pages. Published by Frederick J. Drake & Co. Price, $4.

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PLASTICS—Because of the wide application of plastics in producing equipment and parts for war use, considerable attention has been directed to this field, and a great deal of research has been carried on in producing new methods and plastics. In a small 36-page book the essential points of plastics are outlined. It has basic data on the methods of forming plastics, the principal types of plastics and their characteristics and uses, schools giving courses in plastics, and a bibliography. While this book was prepared particularly for the returning servicemen and women, it should appeal to all who want concise information about the field. For copies write to Society of the Plastics Industry, Inc., 295 Madison Ave., New York 17, N. Y.

CAST-BRASS SOLDER-JOINT FITTINGS — This is a promulgation of simplified practice recommendation R212-45 for cast-brass solder-joint fittings issued by the National Bureau of Standards. Recommendations were proposed to establish a simplified list of types and sizes of cast-brass solder-joint fittings to meet all normal requirements. Recommendations in this report were accepted by the industry and are now being promulgated through the National Bureau of Standards. Types of fittings are illustrated. Report at 5 cents a copy may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

MINERAL WOOL—Recommended Commercial Standards for Industrial Mineral Wool Products, All Types—Testing and Reporting, has been issued by the National Bureau of Standards, U. S. Department of Commerce. It is being mailed to the industry and should there be general approval of these recommendations, they will then become standard. The report provides for uniform methods for testing and reporting the physical and chemical properties of mineral wool products made of rock, slag or glass. Tests are included for abrasive resistance, adhesive strength, compressive strength, corrosion resistance, coverage, density, fire resistance, moisture adsorption, odor emission, shot contents, temperature stability and thermal conductivity. For a copy of TS-4030 write to the U. S. Department of Commerce, Washington 25, D. C.

RATING EQUATIONS—Circular 51 on Rating Equations for Hand-Fired Warm-Air Furnaces has been published by the Engineering Experiment Station of the University of Illinois. Since the standard code rating equation was adopted in 1922 by the National Warm-Air Heating and Air Conditioning Association, some limitations of the original proposal have become obvious. The original test data upon which the standard code rating equation was based have been restudied and the equation has been revised. This revised equation is for all hand-fired coal furnaces converted to stoker, oil or gas firing, hand-fired furnaces having ratios of heating surface to grate area of more than 15 and less than 25 to 1; and hand-fired furnaces having ratios greater than 25 to 1. Circular was prepared by Alonzo P. Kratz, Seichi Konzo and John A. Henry. For copies write to The Engineering Experiment Station, University of Illinois, Urbana, Ill. Price, 60 cents.

ECONOMICS OF INSULATION—Bulletin No. 23 of the Engineering Experiment Station, University of Minnesota, presents the result of research into the question of building insulation. The aim of the project was to show how, within certain calculated limits of weather, insulation thickness, heating plants and other factors in a specified region, the cost of insulating a house would be amortized by yearly fuel savings. This 69-page bulletin shows how to estimate heating requirements, the cost of applying insulation, and it contains an extensive table which gives the heat transmission coefficient for various types of walls with insulation in stud spaces. Copies, at 40 cents each, may be obtained from the Engineering Experiment Station, University of Minnesota, Minneapolis 14, Minn.

SIZE OF DUST PARTICLES.—Carlton E. Brown and Florence L. Feicht, in their investigation of Size of Smallest Dust Particles Revealed by Various Microscopic Systems, used 20 microscopic systems differing in such things as type of illumination, objective and equipment. Determinations were made on 17 dust samples which included 3 of silica dust, 3 of limestone dust and 3 of bituminous dust. Obtainable from the Department of the Interior, Bureau of Mines, Washington, D. C.

NEWS OF THE MONTH

A.S.R.E. HOLDS CONVENTION

New York is host to refrigerating engineers at annual event.

• **41ST MEETING.**—Nine technical papers and three inspection trips were provided for the 740 persons who attended the 41st annual meeting of the American Society of Refrigerating Engineers held at the Hotel Pennsylvania, New York City, December 10 to 12.

Capt. Ellis M. Zacharias, U. S. Navy, told of his broadcasts in Japanese and English to the Japanese people. These broadcasts conducted by the Public Relations Division of the Navy are said to be largely responsible for avoiding an invasion of Japan.

• **SOCIETY AWARDS.**—Honors were bestowed on three members. Life membership in the society was awarded to Dr. Arthur W. Ewell of Worcester Polytechnic Institute. The Wolverine Award for the best paper published in "Refrigerating Engineering" during the past year went to Daniel D. Wile, Carrier Corp., Syracuse, N. Y. for his paper Psychrometry in the Frost Zone. The Chicago section was honored with the Sections Paper Award. A check for $50 went to M. B. Goddard, Carrier Corp., Chicago, for his paper presented before that section on Moisture in Freon Refrigerating Systems.

• **OFFICERS.**—New officers are Charles S. Leopold, consulting engineer, Philadelphia, president; Roland H. Money, The Crosley Corp., Cincinnati, and Clifford F. Holske, Vilter Manufacturing Co., New York City, vice-presidents; Burgess H. Jennings, Northwestern Technological Institute, Evanston, Ill., treasurer. The new directors are John G. Bergdoll, York Corp., York, Pa.; H. C. Diehl, The Refrigeration Research Foundation, Berkeley, Calif.; Dr. Richard C. Jordan, University of Minnesota, Minneapolis; Dr. Mary E. Pennington, consulting engineer, New York City; Arthur B. Schellenberg, formerly president, Alco Valve Co., St. Louis; E. K. Strahan, E. K. Strahan, Inc., New Orleans, and William S. Woodside, United Cork Co., Baltimore.

C. S. Leopold

• **PAPERS.**—Following are the papers presented:

Thermal Conductivity of Insulating Materials at Low Mean Temperatures, by F. B. Rowley, R. C. Jordan, and R. M. Lander, University of Minnesota.

Evaluation of Vibration Isolation Materials for Refrigerating Equipment, by E. S. Bishop and J. A. Galazzi, York Corp.

Educational Guide to Refrigeration and Air Conditioning Training Facilities in the United States, by R. C. Jordan, Chairman, A.S.R.E. Education Committee.

Research and Quality Control of Precooked Frozen Foods, by B. L. Hutchings and C. F. Evers, Birds Eye-Snider Division, General Foods Corp.

Need of Technological Supervision in the Selection, Preparation and Freezing of Fruits and Vegetables, by H. C. Diehl, The Refrigeration Research Foundation.

Some Characteristics of Brines with a Method for Heat Capacity Determinations, by W. A. Pennington, Carrier Corp.

About Odors—Their Nature, Cause and Control, by F. H. Munkelt, W. B. Connor Engineering Corp.

Studies on Odor Elimination in Apple Storage—C. R. Gross and R. M. Smock, Department of Pomology, Cornell University.

• **SOCIAL FEATURES.**—Inspection trips were made to the Merchants Inspection Co. warehouse, the largest cold storage warehouse in the United States, American Airlines at LaGuardia Field, and the U. S. Testing Laboratories, Hoboken, N. J.

On Monday evening the New York Section of the society was host at an informal get-together or Jamboree at which talent from a Broadway show entertained. The annual dinner-dance, preceded by a cocktail party, was held the following night. In addition, there were special events for the ladies.

GERMAN REFRIGERATION STUDIED

U. S. Commerce Department releases Army-Navy reports on German industry.

• **GENERAL.**—A general survey of the German refrigeration industry by Combined Intelligence Objectives Sub-Committee reported by E. T. Simonson, U. S. Engineers, is presented in Report No. 205 of the Publications Board, U. S. Department of Commerce. The report covers outstanding or unique installations or equipment manufacturing facilities but does not pretend to cover the detailed and lengthy examination of research work at the two leading German companies, Linde of Weisbaden and Brown Boveri of Mannheim. Only the main developments as they pertain to the military effort of Germany are reported.

• **U-BOAT.**—Complete plans and specifications for the operation of U-boat Type XXI refrigeration equipment were obtained. It is interesting to note that for this installation reverse cycle heating was used and provision was also made for the making of fresh water by collecting the condensate from the cooling coils. It was reported that these U-boats could leave Germany, go to Japan, and operate there for a period of 2 months, then return to Germany without taking on any fresh water for the crew.

In connection with the installation, it is noted that no by-passes were used around the automatic expansion valves. The coils were constructed of steel as were the condensers. Both air cooling coils and condensers were zinc coated, externally on the coils and overall on the condensers. Remarkable performance records were obtained on this type construction for condensing purposes. A panel board was assembled with simple hand operated valves for reversing the cycle of operation. Elaborate controls were not used.

• **TANKS.**—On the subject of tank air conditioning, the Germans had spent two years of research, employing 15 men. They had conducted tests in a chamber set up to simulate desert conditions. It was found that it was necessary to condition the tank for the radio operator and driver only. Results showed that it was necessary to cool only the heads of these men, and cooling was to have been accomplished by means of a transparent hood which would fit down over the head and shoulders of the operators. The critical point for body cooling was found to be the veins in the temples. The Germans did not find this out until after the campaign in North Africa was over and hence the idea was never used.

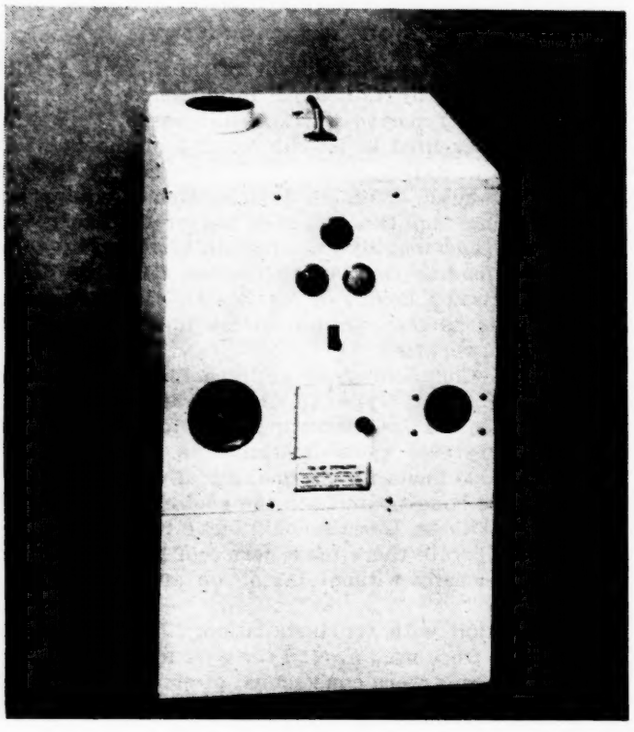
• **CONCLUSIONS.** — The report concludes that the German refrigeration industry had not made any new advances in design technique of compressors during the war. No new refrigerant had been developed and used. However, installation and simplification techniques were highly developed. The refrigeration capacity of Germany was completely engaged during the war and although their facilities were expanded many times they were constantly behind in their deliveries of equipment.

GLYCOL VAPOR KILLS AIR GERMS

Army and private research projects find check for air-borne infections.

• **RESEARCH.**—The Office of the Surgeon General in cooperation with the Douglas Smith Foundation for Medical Research, and the University of Chicago have released results of testing the effects of triethylene glycol as an aerosol in hospitals and army barracks.

Marked germ killing properties of small concentrations of glycol vapor are reported by Morton Hamburger, Jr., Theodore T. Puck, and O. H. Robertson in the *Journal of Infectious Diseases*. While these writers based their quantitative measurements on the mortality of one, easily identified group of streptococci (beta hemolytic), observations indicate that many respiratory



Rogers Diesel and Aircraft Corp.'s glycol vaporizer.

infections including the common cold are subject to the inhibiting action of propylene and triethylene glycol.

• **DUST CONTROL.**—Although glycol vapors are in themselves efficient antiseptics, it has been found that certain bacteria are attached to dust particles, the dryness of which absorbs the glycol and prevents its lethal action on the bacteria. Dust control methods were introduced into the hospital wards during experiments and it was found that dust control alone would reduce bacterial counts only during dust producing activities such as bed making on the wards. At other times, dust prevention treatment had little or no effect on bacteria counts. Glycol vapor, on the other hand, reduced bacteria counts whenever it was introduced. The efficiency of glycol vapor was increased by dust control methods used simultaneously.

The authors believe that the combination of triethylene glycol vapor plus dust preventive treatment of floors and bedclothes offers a promising means of controlling air-borne infection.

• **HUMIDITY.**—Concentrations of glycol as low as 1: 4,000,000 parts of air are found effective under ideal conditions of humidity (40% to 60%), and in wards where tests were conducted the concentration was kept between .0044 and .0091 mg per liter of air. In Army tests conducted by Dr. Robertson and his assistants it was found that one part of triethylene glycol vaporized into 200,000,000 parts of air protected mice against killing doses of influenza virus.

Since glycol vapor is itself a dehumidifying agent (see the article on page 78), a method of maintaining humidity by introducing steam from radiators was used by investigators.

• **METHOD.**—One of the best methods of vaporizing glycol was developed at Northwestern University and used by Dr. Edward Biggs and his associates in army barracks tests. It maintains humidity by evaporating a solution containing both water and glycol.

As manufactured commercially, a unit large enough for a small house will be about the size of a console radio. In New York last month, Ralph B. Rogers, president of Rogers Diesel and Aircraft Corp., announced that his company was going into production on a household glycol vaporizer which operates electrically. The Rogers unit pictured was used in Army and Navy hospital tests, and other models will include a small table unit for one room which will sell for less than $50.

ASHVE PAPERS

Society completes plans for annual convention program.

Program details have been completed for the 52nd annual meeting of the American Society of Heating and Ventilating Engineers that will be held January 27 to 30 at the Hotel Commodore, New York City. The first day, Sunday, has been set aside for meetings of committees and the council.

• **PAPERS.**—Papers to be presented follow:

A Study of Several Coal-Fired Magazine-Feed Space Heaters, by R. C. Cross and H. N. Ostberg.

Application of High Temperature Liquid as a Heat or Energy Transfer Medium for Domestic and Industrial Uses, by O. O. Oaks.

A Single Equation Design Procedure for Radiant Panel Systems, by F. W. Hutchinson.

Low Pressure Properties of Water from —160 to 212F, by John A. Goff and S. Gratch.

Therapeutic Uses of Low Temperature, by Dr. F. M. Allen.

Heating and Ventilation of Transport Aircraft, by B. M. Brod.

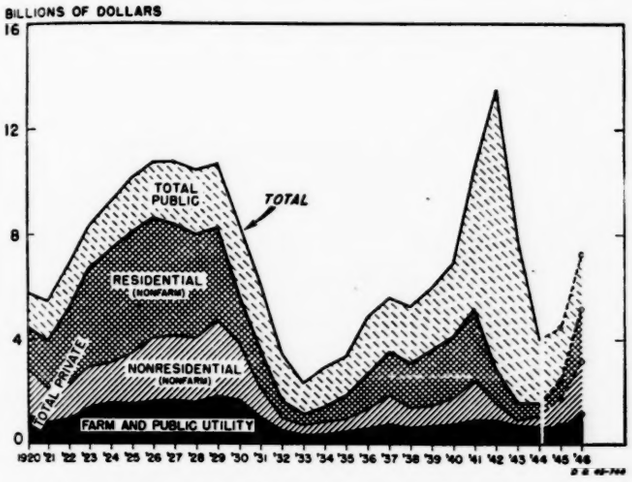
At the welcome luncheon on Monday, Harvey Wiley Corbett will speak on "Are We Over Mechanizing Life?" The informal dinner party is scheduled for Monday evening and the annual banquet on Tuesday evening.

LESS BUILDING IN 1946

Only 300,000 homes next year but construction rate to increase to 500,000 in 1947.

• **BUILDING CUT.**—Because of material shortages, manpower, and the high cost of material needed in the housing industry, Harold W. Sweatt, president, Minneapolis-Honeywell Regulator Co., believes that only about 300,000 new dwellings will be built in the United States in 1946. This compares with the wartime estimates of 600,000 to 1,000,000 new homes a year generally agreed upon by government authorities and members of the housing industry.

• **BOTTLENECKS.**—Major bottlenecks in the housing program today are shortages of lumber, bricks, tile, concrete and metals, Mr. Sweatt revealed, pointing out that supplies of dried lumber suitable for building are practically non-existent and the manpower situation in the lumber industries is critically low. Demands for steel, copper and other metals required for new construction are competing with demands from the automobile and other industries so that severe shortages occur in these fields, too.



U. S. Commerce Dept. chart of 15 years' new Construction activity by types.

Costs for all new construction are uncertain because contractors are unable to obtain firm prices for future delivery. Until there is a free flow of materials and contractors are able to determine their costs, the projected boom in the building industry cannot get underway.

"Although housing is getting off to a slow start, there is little reason for pessimism over the long term, in view of the fact that the nation is now facing the greatest demand for new homes in its history."

He said, "we will reach the expected total of 6,000,000 to 7,000,000 new homes, although these will not be built at the average of 600,000 to 700,000 dwellings a year. With 300,000 new houses built in 1946, the rate will probably increase to a little more than 500,000 in 1947 and after that, providing no unforeseen developments occur in the interim, the housing probably will be well able to supply their current schedules."

IRON FOUNDRIES LAG

Labor shortage and price squeeze continue to hamper casting production.

• **IBRM.**—Production of cast iron boilers and radiators is currently running at from 50% to 60% of normal for boilers and 25% of normal for radiators, according to R. E. Ferry, general manager of the Institute of Boiler and Radiator Manufacturers. This low production, says Mr. Ferry, is largely due to inability to obtain foundry labor.

• **SMA.**—The manufacture of stokers has suffered considerably from a shortage of foundry castings, as reported by Marc G. Bluth, executive secretary of the Stoker Manufacturers Association. "As far as materials are concerned," says Mr. Bluth, "it has been and still is the chief bottleneck in getting into a larger production program. We are also running into difficulties in fractional horsepower motors. I should say, however, that with winter coming on the foundry situation will continue to improve considerably and that by next spring we will be able to secure a reasonable tonnage of castings to meet our anticipated heavier schedules of production for 1946."

• **WPB.**—According to figures from the Steel Division, War Production Board, as reported by the Department of Commerce, production of cast iron soil pipe was about 30% of reported capacity (as of July) and is running about 14 months behind orders. Cast iron pressure pipe mills also produced about one third of reported capacity and backlog is about four months.

• **OPA.**—W. L. Seelbach, president of the Gray Iron Founders Society, in a statement reported by the *Cleveland Plain Dealer* last month, blamed the foundry bottleneck on lack of manpower and policies of the Office of Price Administration. "The OPA has limited us to a 4% profit before taxes," said Mr. Seelbach. "This has curtailed production and discouraged new venture capital." He says foundry production costs are up 20% to 25% not including any prospective labor cost increase.

• **OWMR.**—The Office of War Mobilization and Reconversion has set up a subcommittee on gray iron castings within its reconversion working committee, and the Gray Iron Founders' Society has been asked for a roster of all men with foundry skills who have been in the service at least a year and are still in this country.

SPORN GETS EDISON MEDAL

Writer–Inventor recognized for achievement in electrical sciences.

• **MEDAL.** — The Edison Medal for 1945 has been awarded by the American Institute of Electrical Engineers to Philip Sporn, executive vice-president, American Gas & Electric Service Corporation, "For his contributions to the art of economical and dependable power generation and transmission."

The medal will be presented to Mr. Sporn on Wednesday morning, January 23, 1946, in the Engineering Auditorium, 33 West 39th Street, New York, in a general session of the Winter Convention of the American Institute of Electrical Engineers, to be held January 21-25.

P. Sporn

The Edison Medal was founded by associates and friends of Thomas A. Edison, and is awarded annually for "meritorious achievement in electrical science, electrical engineering, or the electrical arts" by a committee composed of 24 members of the American Institute of Electrical Engineers.

• **WRITER.**—Mr. Sporn has presented numerous papers before the AIEE and other professional groups and has contributed extensively to technical journals.

One phase of his work, dealing with the reverse cycle heat pump for winter heating and summer cooling of buildings, he described in HEATING AND VENTILATING (Feb. 1944 and July, 1945) in two articles which he co-authored with E. R. Ambrose.

• **EXECUTIVE.** — Executive vice-president, American Gas & Electric Service Corporation, he is executive vice-president and chief engineer or director of 15 subsidiaries of the parent organization. Employed by AG&E in 1920, he has progressed through positions of protection engineer, communication engineer, transmission and

distribution engineer, station engineer, chief electrical engineer, and chief engineer to his present position.

• **INVENTOR.** — Mr. Sporn is recognized as inventor, engineer of power system design and operation and as leader of the long-term move to subdue lightning as a disturber of service continuity. Among his patents is one on high speed carrier current relaying of high voltage transmission lines. He proposed in 1937 the ultra high speed reclosure of circuit breakers which has since been widely accepted as a means of furthering stability and dependability of high voltage transmission circuits. He has carried out pioneer developmental work in the application of hydrogen to the cooling of alternators and synchronous condensers.

HOT WATER FOR WASHERS

Surveys show automatic laundry requirements.

• **WESTINGHOUSE.**—A fact finding survey to establish water requirements in the homes of automatic washer customers has been announced by I. Frank Brownson, manager of the Laundry Equipment department of the Westinghouse Electric Appliance Division, Mansfield, Ohio.

The study was conducted by Mrs. Julia Kiene, director of the Westinghouse Home Economics Institute, and a questionnaire booklet was sent to 9,067 owners of Laundromat automatic washers of whom 2,240 replied.

The survey covered a consumer group that had used Laundromats for at least two years and revealed not only factual data on consumer use of water in automatic washers, but unusual statistics on the prior use by these people of conventional type washers.

• **DATA.**—From the results of this study, it was computed that water requirements for users of conventional washers totaled 96 gallons of mixed hot and cold water to do the average weekly wash of four loads. These figures were based on filling the washer and two rinse tubs twice during the laundry period.

Mrs. Kiene in her report pointed out that the conventional washday consumes three hours, and this finding corroborated time and motion studies conducted by the Westinghouse Home Economics Institute for washing four loads of clothes with conventional equipment.

The mixed hot and cold water consumption for the Laundromat for four loads of clothes is 82 gallons, or, 20.5 gallons for each load of clothes. In addition, when it is necessary to prewash clothes—a washing action soak which, in a few minutes, accomplishes the same result as overnight soaking—six more gallons of water are used per load.

• **TAKES HOT WATER.**—"In our study of the use of hot water in automatic washers," Mrs. Kiene said, "It is necessary to keep two facts in mind: one, that it takes hot water to wash clothes clean in any machine; and two, that the automatic washer radically changes washday habits."

In a recent Pennsylvania State College study at the Ellen H. Richards Institute, it was found that temperatures higher than those ordinarily used in household practice gave better soil removal results, as well as more satisfactory removal of many stains. This study showed that temperatures of 140F to 145F were the most practical for home laundering of fabrics which may be washed safely with hot water. The usual temperature for household washing, the report stated, was 100F to 120F.

The Westinghouse hot water requirements survey definitely established the fact that users of automatic washers were acquiring the habit of putting a load of clothes through the Laundromat whenever enough of a particular type accumulated.

The survey showed that the average Laundromat owner washes six loads per week, instead of the four with conventional equipment. There are two reasons for this: (1) She washes many articles formerly sent to the laundry and dry cleaners, a 50% increase in loads. (2) Other articles are washed more frequently.

From this study it was determined just what water requirements were for these users of automatic washers. Details on calculating hot water needs for automatic washer users are given in the survey, "The Study of Hot Water Requirements of Automatic Washers," from which Table 1 is shown.

• **BENDIX.**—Adequate hot water supply, says Walter J. Daily, advertising director of Bendix Home Appliances, Inc., is best assured by a quick-recovery, 30-gal-tank heater. The Bendix automatic washer handles about 9 lb of clothes at once and the average family wash runs about 27 lb. This means that the machine will require about 44 gal hot water if all the washing is done at the same time.

O. L. Bock, in the December *Fuel Oil & Oil Heat*, shows that a 20-gal-tank heater may come close to fulfilling the requirements for one load of the Bendix washer provided no other demand is placed on the

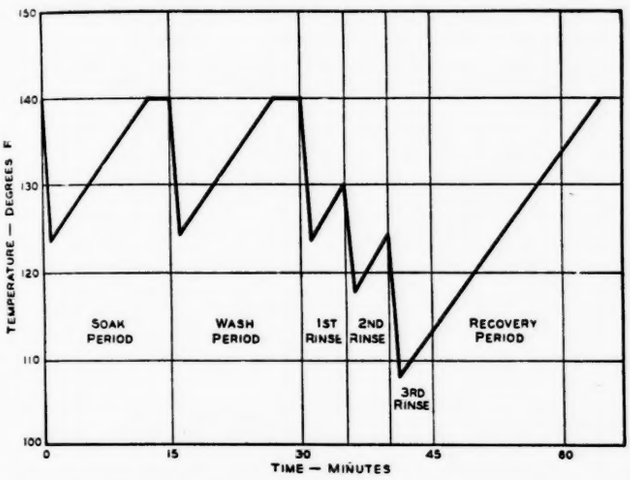
TABLE 2.—WATER CONSUMPTION DATA FOR BENDIX WASHER

	Hot Water Draw	Cold Water Draw	Total Draw	Time Elapsed in Minutes
Soak Period	4.1	2.03	6.13	15
Wash Period	4.0	1.98	5.98	30
First Rinse	4.1	2.41	6.51	35
Second Rinse	3.7	2.36	6.06	40
Third Rinse	5.1	2.90	8.00	45
Totals	21 0	11.68	32.68	45

TABLE 1.—LAUNDROMAT WEEKLY HOT WATER REQUIREMENT

No. of Loads	Temperature Dial Setting	Gallons Hot Water Used					
		140F Tank Temperature			150F Tank Temperature		
		50F Tap	60F Tap	70F Tap	50F Tap	60F Tap	70F Tap
2	Cotton (Prewashed)	41.48	40.04	38.20	37.34	35.60	33.42
2	Cotton (Not Prewashed)	35.08	34.34	33.40	31.58	30.54	29.22
1	Silk (Not Prewashed)	13.81	13.00	11.92	12.45	11.55	10.43
1	Colors (Not Prewashed)	12.09	11.02	9.67	10.88	9.82	8.46
	Total hot water used per week—6 loads	102.46	98.40	93.19	92.25	87.51	81.53

heater simultaneously. Assuming the tank water temperature to be 140F and the temperature required for the ordinary cotton wash to be 140F (in agreement with Westinghouse practice) and the recovery rate of the heater to be 20 gal per hr through an 80 degree temperature rise, Mr. Bock plots a chart of the tank temperature variation showing that the tank temperature recovers fully during the washing period, but goes down during the more frequent demands of the rinsing cycles. The 30-gal-tank heater with a 30 gal per hr recovery rate, on the other hand, finishes the complete washing and rinsing cycle at a tank temperature of 126F instead of 114.5F as in the 20 gal heater.



Fluctuation of water temperature in 20-gal tank during Bendix washing cycle, according to Bock.

• **LOAD.**—Westinghouse points out that in considering hot water requirements for the Laundromat, the minimum quantity of hot water for any two loads must be delivered within one hour and 20 minutes. Mrs. Kiene's report concludes that if the users of automatic washers are to get reasonably satisfactory results they need water heaters that will deliver 40 gal of at least 140F water in a period of one hour and 20 minutes.

FUELS IN THE NEWS

From Big Inch to atom heat, fuels are center of interest.

• **BIG INCH TO GAS?**—A special Senate Committee has been holding hearings in Washington to develop ideas and suggestions, notably from the oil industry, about what should be done with both Big and Little Big Inch after they were shut down on oil.

A Petroleum industry committee, Committee on Postwar Disposal of Pipe Lines, Refineries and Tankers, has been active under the Chairmanship of W. Alton Jones, President of Cities Service Company. This Committee was named by several trade associations including American Petroleum Institute, Independent Natural Gas Association of America, Mid-Continent Oil & Gas Association, and American Gas Association. On November 16th the Committee submitted a statement to the Senate Committee on "Big Inch Pipeline Systems—Post-war Prospects as a Natural Gas System."

Opposition to the use of the pipe lines for transmission of natural gas has been presented by the National Coal Association, the Anthracite Industry, Association of American Railroads and United Mine Workers of America.

The Army-Navy Petroleum Board apparently approves turning over the lines to private industry but with a clause to permit Government to recapture in event of need in some future emergency if such clause would not prevent sale of the lines. The Natural Gas Industry is, of course, in favor of Government sale.

• **WIRED FUEL.** — Nearly 400,000 kilowatts of the combined Bonneville-Grand Coulee war load of approximately 1,300,000 kilowatts were dropped with the cancellation of war contracts but Bonneville officials are not dismayed by the loss.

The Bonneville Power Administration is now actively negotiating with other industries which will manufacture new-type chemicals, plastic and metallic products and with others who will use the new powder metallurgy. Present negotiations involve potential use of better than 100,000 kilowatts.

Use of electric-steam boilers, of which sizable numbers are now in operation, may take an additional 250,000 kilowatts, while electric home heating has tremendous possibilities, in the opinion of Ivan Bloch, chief of B. P. A.'s division of industrial development. He foresees 1,000,000 kilowatts being used for this purpose by 1960. Home heating would be seasonal in character, leaving large blocks of power for other parts of the year.

• **FUEL OILS.** — The Office of Price Administration moved to check a threatened shortage of heating fuels along the Eastern Seaboard this winter by increasing the prices of kerosene and fuel oil in the East Coast and Gulf districts of the Petroleum Administration for War.

Effective immediately and continuing until April 30, ceiling prices of kerosene, range oil and No. 1 fuel oil were raised half a cent a gallon, and the prices of No. 2, 3 and 4 fuel oils were increased two-tenths of a cent a gallon.

The action followed a recommendation by the East Coast Fuel Oil Industry Advisory Committee that ceilings for these fuels should be increased as an incentive to refiners to make more of these products and less gasoline from their supplies of crude oil.

• **ATOMS.**—The harnessing of atomic energy to replace present sources of power was predicted for the near future by leading scientists, engineers and social scientists who combined their description of a new era with a strong plea for the establishment of an international authority to control society in such an advanced world.

The economic and political aspects of world-wide use of atomic energy were discussed at a conference sponsored by the Nation Associates at the Hotel Astor. Six hundred persons attended the session.

The most concrete description of things to come was offered by Boris Pregel, president of the Canadian Radium Uranium Corporation, who worked with Canadian scientists and engineers on the development of the atomic bomb. Mr. Pregel, asserting that the atomic "revolution" was now under way, held that the "applications of atomic energy to civilian life are possible, imminent and even unavoidable."

Pointing to a recent statement by Dr. J. Robert Oppenheimer, a leading authority on atomic energy, saying it was feasible for a city the size of Seattle to be completely heated from an atomic energy source within five years, Mr. Pregel declared the first important application of atomic energy would be the production of a cheap power by large plants not dependent on any natural resource.

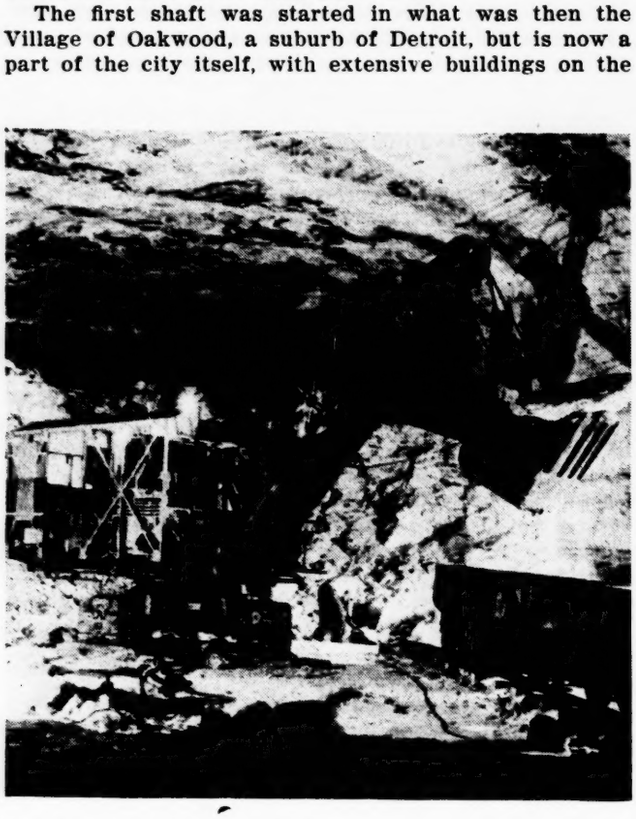
• **COAL.**—After referring to the atomic bomb dropped on Hiroshima, Aug. 6, as a direct result of the "world's largest research project," T. A. Day, special representative of Bituminous Coal Research, Inc., Pittsburgh, Pa., told members of the Michigan Retail Coal Merchants Association that their industry also is spending dollars for research. Backed by more than 200 million tons of annual production, the research agency of the bituminous coal industry is spending about one thousand dollars a day.

SALT MINE UNDER DETROIT

Two hundred acres of salt are worked eleven hundred feet below the streets.

• **DOWN UNDER.**—Of the thousands of people who daily tread the busy streets of Detroit, Mich., many are wholly unaware that far beneath them is a huge salt mine, covering 200 acres of rich saline deposits, with more than 25 miles of passageways to the stopes or blasted out chambers from which the rock salt is removed. The floor of this mine is 1137 ft under ground, and so large is the mine that foremen, mechanics and supervisors use automobiles to reach the chambers where the mineral is being blasted out.

The first shaft was started in what was then the Village of Oakwood, a suburb of Detroit, but is now a part of the city itself, with extensive buildings on the surface. It is owned by the International Salt Co., Inc. of Scranton, Pa., and is one of the best ventilated mines of its type in the country.



Salt blasted out by night is loaded into mine cars by day.

Access to the mine is gained through two vertical shafts 16 ft in diameter, one of them circular in shape, lined with concrete and brick. The concrete shaft is used for hoisting the mined rock salt to the surface as well as conveying the men in and out of the mine. The second shaft consists of twin tubes, each 42 in. in diameter, through which double deck skips hoist men and materials in and out of the mine. The other shaft also has two skips.

• **VENTILATION.**—A segment of one shaft is partitioned to make an air duct to the workings, through which 35,000 cfm are forced into the mine for ventilation, by a blower located on the surface near the shaft. The airway is 42 ft in horizontal area and airflow is continuous, 24 hours a day.

From the foot of the duct the air flows into a tunnel cut in the salt vein for a distance of a mile, without splits or vents. Beyond this point air movement is controlled and directed by brattices to sweep the faces of the chambers in the mining area. This long duct varies in diameter from 600 to 1200 sq ft, the air currents reaching to the extreme limits of the workings.

Air return is through previously worked out areas to a second shaft near the main one, where it rises to the surface. The entire mine is dry and healthful. Where many mines are confronted with seepage, the only moisture here is around the shafts, where water is pumped out at the rate of 20 gallons a minute, part of the water being, perhaps, condensation from air in and around the shafts.

• **BLAST BY NIGHT.**—Mining operations such as drilling, ore car loading and movement of employees, are conducted in the daytime, while blasting is done at night. The constant flow of air is sufficient to clear away blasting fumes before the day shift starts to work. Temperatures in the mine are fairly uniform at 57F the year round. However, in winter the air is heated before entering the blower, to prevent frost damage to the concrete and brick shaft walls. Two gun type oil burners and two steel warm air furnaces near the shaft are used for heating the air. The mined chambers average about 22 ft high by 50 to 60 ft wide and are cut about 10 ft into the vein.

Rooms are cut on the checkerboard pattern, chambers alternating with solid rock salt columns 50 to 60 ft square, left for roof support. An average of four rooms is blasted every night, with several blasts in each room. All blasts are conducted from one central control board.

GRANTS FROM PATENTS

Research Corp. derives revenue from electrical precipitation rights and other patents.

• **ORIGIN.** — Research Corp., which offers research grants preferably to smaller colleges, was begun in 1912 with the gift, through Dr. F. G. Cottrell, of patent rights on electrical precipitation of dust, fumes, and mists from industrial atmospheres. From revenues derived from these and other patents it has made grants of $1,279,637 in past years to 52 institutions.

ARTHUR S. ARMAGNAC

Editor and publisher dies at N. J. home.

• **EDITOR.**—Arthur Stowell Armagnac, for 26 years editor and 22 years co-publisher of HEATING AND VENTILATING, died at his home in Upper Montclair, N. J., December 21.

Mr. Armagnac was born in Tarrytown, N. Y., in 1877 and began his career as a reporter on *The New York Times* in 1898. He became editor of *The Heating and Ventilating Magazine* in 1904, and in 1908 he and Gustav Peterson acquired the publication through purchase of Heating and Ventilating Magazine Company, and Mr. Armagnac continued in the capacity of editor. At the time Mr. Armagnac became editor the magazine was little larger than pocket size but was later made standard size and greatly increased in prestige, circulation and advertising revenue. Late in 1928 the two partners sold the magazine, as well as another monthly business paper, *Oil Heat*, which they had founded a few months before. Mr. Armagnac continued as editor of HEATING AND VENTILATING until 1930. Since that time, although ill for several years, Mr. Armagnac was an editor of *Sheet Metal Worker*.

Mr. Armagnac leaves his widow, Mrs. Ada Packard Armagnac; two sons, Alden P. and Maxim R., two sisters and a granddaughter.

No other material used for heating and water lines can give you the same feeling of security and peace-of-mind as copper. For no other metal used for this purpose has the permanent immunity to rust. Clear, rust-free water, unobstructed flow through the lines, and absence of those complaints caused by wet walls and ceilings due to leaks—these are points you can take advantage of to enhance your professional reputation. If copper were a costly material this might be something to consider, pro and con. But Revere Copper Water Tube, as all experienced engineers have learned, is usually much more economical in the end than any kind of rustable material.

Revere Copper Water Tube (99.9% pure copper) is seamless and is cold drawn with a gun-barrel finish inside. It is deoxidized, and is free from flaws and blemishes. Joints are made with either soldered or compression fittings.

Made for water supply, heating, air conditioning and other services in all types of buildings, this tube is stamped with the Revere name and the type at regular intervals. Look for these identification marks — they insure full wall thickness and the close gauge tolerances essential for tight sweated joints.

In making your plans you can specify or use such long-lived Revere materials as Copper Water Tube and Red-Brass Pipe; Sheet Copper for tanks, ducts, pans and trays; Sheet Herculoy for tanks; Dryseal Copper Refrigeration Tube (Dehydrated and sealed); Copper oil burner, heat control and capillary tubes.

Revere materials are handled by Revere Distributors in all parts of the country. The Revere Technical Advisory Service, Architectural, is always ready to serve you. Call your Revere Distributor.

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Degree-Days for November, 1945

HEATING AND VENTILATING'S 19TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

CITY	NOVEMBER			CUMULATIVE, SEPTEMBER 1 TO NOVEMBER 30			HEATING SEASON[1]
	1945	1944	NORMAL	1945	1944	NORMAL	NORMAL
Abilene, Texas	262	314	333	389	366	333	2061
Albany, New York	759	786	774	1372	1347	1292	6580
Albuquerque, New Mexico	593	660	630	851	881	903	4298
Alpena, Michigan	826	778	912	1657	1546	1704	8299*
Anaconda, Montana	1029	1082	951	1922	1802	1933	8357**
Asheville, North Carolina	516	596	576	834	885	852	4232
Atlanta, Georgia	361	422	396	494	560	492	2890
Atlantic City, New Jersey	465	553	588	713	840	842	5176
Augusta, Georgia	261	327	321	342	398	337	2161
Baker, Oregon	887	907	849	1664	1466	1659	7163
Baltimore, Maryland	464	515	567	689	788	790	4533
Billings, Montana	908	893	909	1614	1422	1622	7119
Binghamton, New York	706	750	798	1288	1374	1359	6808
Birmingham, Alabama	340	390	318	481	479	318	2352
Bismarck, North Dakota	1229	1155	1113	2133	1851	1961	9192
Block Island, Rhode Island	539	602	573	910	985	852	5788
Boise, Idaho	762	786	738	1296	1138	1274	5552
Boston, Massachusetts	584	657	693	1023	1110	1104	6045
Bozeman, Montana	1037	982	1006	1922	1719	1993	8521**
Buffalo, New York	727	695	774	1322	1281	1268	6822
Burlington, Vermont	822	832	861	1558	1584	1486	7514
Butte, Montana	1078	1091	923	2102	1935	1922	8272
Cairo, Illinois	471	470	519	677	635	677	3909
Canton, New York	868	859	906	1644	1645	1652	8020
Charles City, Iowa	942	786	936	1644	1350	1505	7588
Charleston, South Carolina	200	247	207	245	293	207	1769
Charlotte, North Carolina	366	438	426	508	607	541	3120
Chattanooga, Tennessee	411	490	426	609	701	531	3118
Cheyenne, Wyoming	810	875	900	1658	1589	1745	7466
Chicago, Illinois	710	620	450	1175	1070	800	5957
Cincinnati, Ohio	578	611	615	894	943	869	4684
Cleveland, Ohio	626	618	732	1090	1082	1125	6155
Columbia, Missouri	591	581	651	941	816	911	4922
Columbia, South Carolina	270	340	324	358	437	355	2364
Columbus, Ohio	623	637	690	1001	1005	1003	5398
Concord, New Hampshire	812	843	846	1532	1559	1498	7353
Concordia, Kansas	647	653	693	1022	908	969	5315
Dallas, Texas	206	259	303	299	289	303	2256
Davenport, Iowa	774	670	795	1285	1027	1158	6289
Dayton, Ohio	676	685	660	1131	1081	933	5264
Denver, Colorado	721	688	759	1255	1081	1259	5874
Des Moines, Iowa	770	698	798	1244	1052	1155	6384
Detroit, Michigan	699	676	777	1241	1155	1219	6490
Devils Lake, North Dakota	1370	1146	1179	2422	1943	2161	9970
Dodge City, Kansas	564	621	672	936	909	948	5035
Dubuque, Iowa	838	734	846	1434	1187	1291	6790
Duluth, Minnesota	1137	924	1074	2135	1759	1970	9443
Eastport, Maine	792	754	843	1590	1536	1662	8520*
Elkins, West Virginia	673	750	741	1202	1341	1182	5697
El Paso, Texas	310	412	381	422	461	421	2428
Ely, Nevada	973	1034	—	1815	1824	—	—
Erie, Pennsylvania	630	603	711	1094	993	1125	6273
Escanaba, Michigan	928	800	960	1816	1593	1794	8771*
Evansville, Indiana	569	558	528	871	852	683	4244
Fort Smith, Arkansas	372	365	408	532	420	470	3147
Fort Wayne, Indiana	741	724	726	1307	1244	1073	5925
Fort Worth, Texas	204	260	252	292	284	252	2148
Fresno, California	345	407	315	387	427	334	2334
Galveston, Texas	43	109	60	67	114	60	1016
Grand Junction, Colorado	791	707	747	1161	919	1116	5548
Grand Rapids, Michigan	741	693	774	1353	1211	1250	6535
Green Bay, Wisconsin	916	739	921	1700	1399	1558	7825
Greensboro, North Carolina	480	544	492	720	815	635	3529
Greenville, South Carolina	408	453	450	560	621	596	3380
Harrisburg, Pennsylvania	613	622	660	1015	1040	989	5375
Hartford, Connecticut	678	741	705	1187	1258	1097	6036
Hatteras, North Carolina	216	327	234	271	401	234	2571
Havre, Montana	1144	1195	1041	1995	1800	1931	8700
Helena, Montana	999	1027	948	1864	1800	1813	7898
Houston, Texas	75	147	114	108	155	114	1157
Huron, South Dakota	1038	949	1005	1740	1561	1654	8004
Indianapolis, Indiana	645	625	672	1015	951	964	5298
Jackson, Miss.	235	266	—	332	341	—	—
Kansas City, Missouri	566	556	639	881	724	858	4956
Kewanee, Illinois	787	639	781	1138	985	1193	6139
Knoxville, Tennessee	433	541	519	656	764	702	3670
La Crosse, Wisconsin	942	735	909	1717	1252	1467	7322
Lander, Wyoming	1050	1189	726	1897	1959	1656	7947

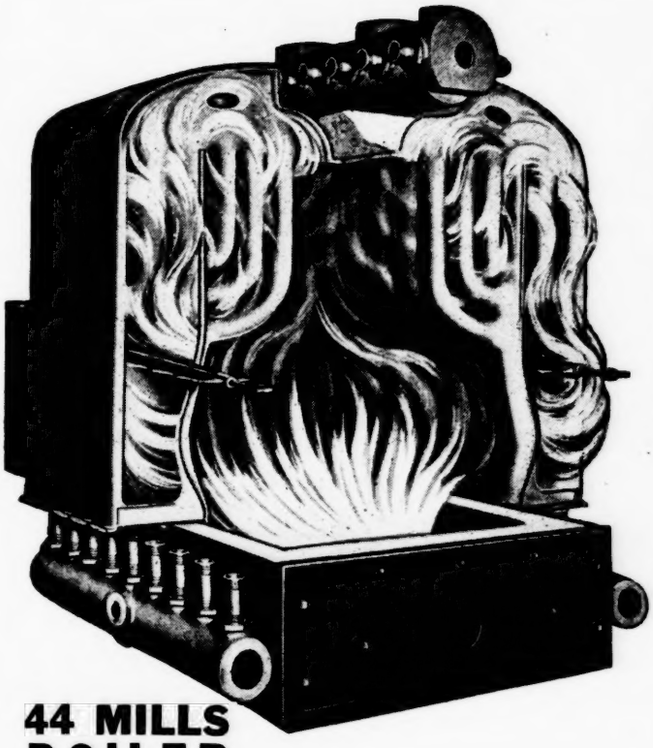
[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with nine exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, Sioux City, and Jackson, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Depa ment, Kewanee Boiler Corp., Kewanee, Ill.; Alfred R. Wagstaff, Engine Sioux City Foundry and Boiler Co., Sioux City, Iowa, and H. M. Ludlow, E 1368, Jackson, Miss., respectively; Anaconda, Bozeman, Butte and Livingst Mont., through the courtesy of the Montana Power Company.

(a) Data not available.

[Table concluded on page 10

FOR AUTOMATIC FIRING...



44 MILLS BOILER

"Mills" boilers have capacities from 600 sq. ft. to 11,400 sq. ft. of installed steam radiation.

MILLS BOILERS *take the lead!*

For years H. B. SMITH "MILLS" boilers have been acknowledged as the leaders in their field. Now, more and more engineers are coming to realize the reasons *why* these units are uniquely suited to installations where top performance with oil, gas or stoker is a No. 1 requirement.

Here are just a few "Mills" exclusive features. Think them over carefully before selecting a boiler for that important job you are figuring now.

- ✓ — *WATER TUBE construction* promotes efficient water circulation, fast steaming.
- ✓ — *MORE prime heating surface* than any other boiler of comparable physical dimensions. Assures a high degree of heat absorption and hence high operating efficiencies at 100% of rating.
- ✓ — *MADE of rugged cast iron* for long service, low maintenance.
- ✓ — *HEADER TYPE CONSTRUCTION* minimizes possibility of mid-season breakdown.
- ✓ — *CONVERTIBLE* from one fuel to another both easily and inexpensively.

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CAST-IRON BOILERS

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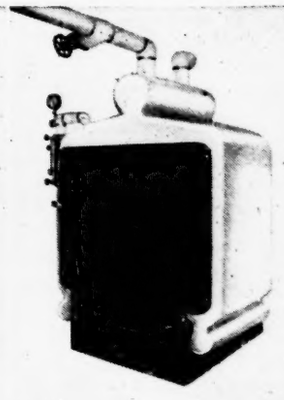
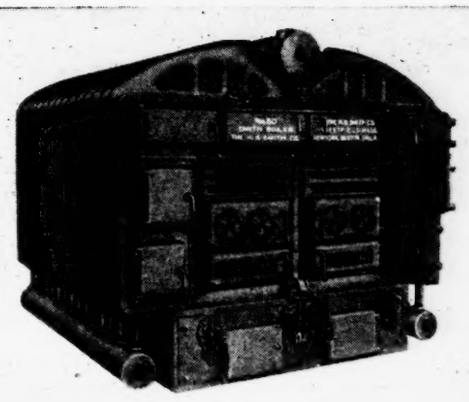


42 and 60 Smith Boilers for Large Installations



Smith Hot Water Supply Boilers

Degree-Days for November, 1945 (Concluded)

HEATING AND VENTILATING'S 19TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

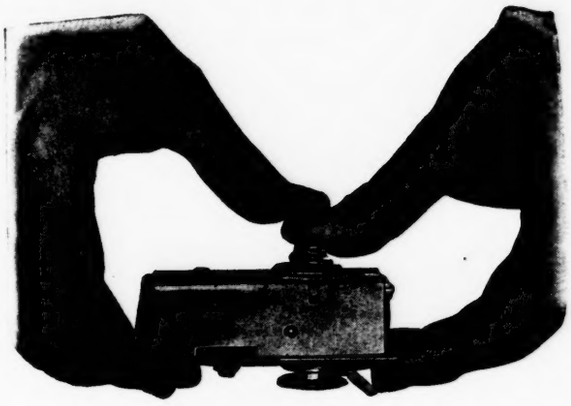
CITY	NOVEMBER			CUMULATIVE, SEPTEMBER 1 TO NOVEMBER 30			HEATING SEASON[1]
	1945	1944	NORMAL	1945	1944	NORMAL	NORMAL
Lansing, Michigan	772	761	861	1483	1422	1456	7048
Lewiston, Maine	853	835	876	1647	1577	1542	7707
Lincoln, Nebraska	696	731	753	1095	1031	1069	5999
Little Rock, Arkansas	358	376	381	515	463	428	2811
Livingston, Montana	901	944	864	1703	1691	1614	7205
Los Angeles, California	138	182	123	167	221	123	1504
Louisville, Kentucky	513	537	552	763	782	738	4180
Lynchburg, Virginia	511	588	537	777	905	757	3980
Macon, Georgia	(a)	350	324	(a)	444	330	2201
Madison, Wisconsin	889	746	891	1572	1288	1437	7429
Marquette, Michigan	947	814	960	1836	1583	1752	8693*
Memphis, Tennessee	386	404	402	558	544	464	2950
Meridian, Mississippi	239	319	312	333	418	334	2160
Milwaukee, Wisconsin	793	709	846	1403	1221	1380	7245
Minneapolis, Minnesota	997	819	963	1730	1384	1537	7850
Modena, Utah	819	893	831	1407	1425	1504	6562
Montgomery, Alabama	241	267	273	308	322	273	1884
Nantucket, Massachusetts	529	604	609	910	985	1007	5957
Nashville, Tennessee	455	494	483	679	703	619	3507
New Haven, Connecticut	640	694	693	1091	1160	1092	5895
New Orleans, Louisiana	94	114	102	106	127	102	1024
New York, New York	530	571	618	839	889	894	5347
†Nome, Alaska	1140	1492	1509	1800	3322	3379	14580**
Norfolk, Virginia	338	420	411	445	556	510	3350
North Head, Washington	572	493	510	1265	962	1131	5452**
North Platte, Nebraska	737	824	837	1250	1251	1313	6366
Oakland, California	365	364	330	588	583	603	3143**
Oklahoma City, Oklahoma	355	404	459	530	489	564	3631
Omaha, Nebraska	755	738	780	1186	1058	1109	6131
Oswego, New York	721	733	783	1310	1340	1356	7088
Parkersburg, West Virginia	559	629	624	898	1008	909	4775
Peoria, Illinois	766	661	789	1286	1068	1173	6109
Philadelphia, Pennsylvania	496	530	588	772	815	830	4855
Phoenix, Arizona	189	234	156	191	234	156	1405
Pittsburgh, Pennsylvania	588	601	669	990	987	982	5235
Pocatello, Idaho	894	976	813	1598	1576	1468	6655
Portland, Maine	819	806	807	1590	1540	1446	7218
Portland, Oregon	1545	537	558	1944	818	995	4469
Providence, Rhode Island	579	643	693	991	1035	1104	6015
Pueblo, Colorado	696	759	741	1187	1159	1135	5514
Raleigh, North Carolina	359	462	429	513	649	559	3234
Rapid City, South Dakota	884	961	870	1585	1494	1529	7118
Reading, Pennsylvania	575	595	669	931	979	1013	5389
Red Bluff, California	418	423	—	477	452	—	—
Reno, Nevada	741	803	714	1289	1332	1311	5892
Richmond, Virginia	423	483	456	619	712	617	3695
Rochester, New York	735	726	786	1340	1351	1289	6732
Roseburg, Oregon	535	594	561	928	852	1022	4428
Roswell, New Mexico	393	485	516	630	642	702	3484
Sacramento, California	352	403	351	407	437	422	2653
St. Joseph, Missouri	633	614	633	1002	822	881	5161
St. Louis, Missouri	576	552	597	846	742	802	4585
Salt Lake City, Utah	774	757	723	1292	1038	1129	5555
San Antonio, Texas	121	220	126	180	236	126	1202
San Diego, California	160	157	165	173	188	199	1645
Sandusky, Ohio	639	636	726	1068	1057	1079	6208
San Francisco, California	268	273	261	501	549	521	3264**
Sault Ste. Marie, Michigan	976	913	978	1999	1852	1877	9285**
Savannah, Georgia	195	214	201	241	249	201	1490
Scranton, Pennsylvania	662	719	732	1179	1293	1189	6129
Seattle, Washington	559	515	570	1043	839	1150	4934**
Sheridan, Wyoming	958	919	978	1702	1484	1878	8008
Shreveport, Louisiana	231	262	270	312	320	270	1938
Sioux City, Iowa	897	833	870	1481	1302	1318	6898
Spokane, Washington	849	846	819	1555	1329	1526	6355
Springfield, Illinois	668	1019	681	1016	1277	963	5373
Springfield, Missouri	551	558	564	868	780	781	4428
Syracuse, New York	733	734	798	1334	1353	1319	6893
Tacoma, Washington	590	568	588	1204	981	1195	5181**
Terre Haute, Indiana	638	595	615	989	902	848	4872
Toledo, Ohio	708	719	732	1252	1242	1110	6077
Topeka, Kansas	570	567	639	887	742	875	4969
Trenton, New Jersey	540	597	681	890	969	1033	4933
Utica, New York	778	823	781	1457	1528	1393	6796
Valentine, Nebraska	868	945	897	1505	1509	1480	7039
Walla Walla, Washington	643	729	651	1031	979	1013	4808
Washington, D. C.	485	526	594	741	830	845	4626
Wichita, Kansas	518	525	636	810	698	828	4673
Williston, North Dakota	1321	1181	1137	2298	1863	2067	9323
Winnemucca, Nevada	801	930	810	1424	1432	1509	6427**
Yakima, Washington	809	802	780	1260	1072	1337	5599

†Nome data are for October.
(a) Data not available.

*Includes August.
**Includes July and August.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

★ UNUSUALLY *STURDY* SWITCH CONSTRUCTION



POSSIBLE BECAUSE OF THE SOLID-LIQUID CHARGE

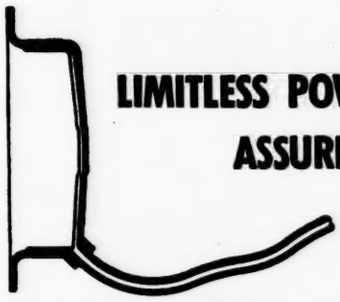
Switches on White-Rodgers controls are so sturdy and strong that it takes all the pressure you can exert with *two* thumbs to make them click. The power of Hydraulic-Action is so great that it readily overcomes this resistance. Because of that power, White-Rodgers can and does build a better, *sturdier* switch into all its controls—a switch that is built to last.

HYDRAULIC ACTION CONTROL

8 EXCLUSIVE FEATURES OF WHITE-RODGERS HYDRAULIC-ACTION TEMPERATURE CONTROLS

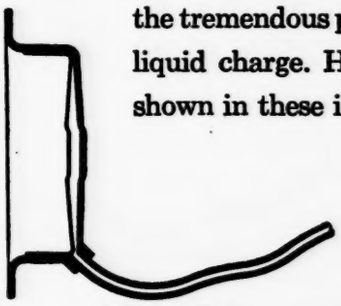
1. May be mounted at any angle or position, above, below or on level with control point.
2. Hydraulic-Action principle incorporating solid-liquid filled bulb and capillary provides expansion force comparable to that of a metal bar.
3. Diaphragm motion uniform per degree of temperature change.
4. ★ Power of solid-liquid charge permits unusually sturdy switch construction resulting in positive contact closure.
5. Heavier, longer-wearing parts are possible because of unlimited power.
6. Dials are evenly and accurately calibrated over their entire range because of straight-line expansion.
7. Controls with remote bulb and capillary are not sensitive to change in room temperature. Accuracy of control is not affected by temperature changes in surrounding area.
8. Not affected by atmospheric pressure. Works accurately at sea level or in the stratosphere without compensation or adjustment.

LIMITLESS POWER OF HYDRAULIC-ACTION ASSURES POSITIVE CONTACT



CONTRACTED

Above is a cross section of the diaphragm and part of the liquid-filled capillary. In this view the liquid has contracted, releasing the pressure on the diaphragm and causing the switch contacts to function.



EXPANDED

In this cross-sectional view, the liquid charge of the capillary has expanded with a rise in temperature. The positive force of this hydraulic action forces the diaphragm outward and causes the switch contacts to function.

Every part of White-Rodgers Hydraulic-Action controls is built stronger and *sturdier* because of the tremendous power of the solid-liquid charge. How this works is shown in these illustrations.

Actual-size illustration of the White-Rodgers diaphragm body, the actuating element of every White-Rodgers temperature control. It is so designed as to exert full pressure at the point of contact with the switch mechanism.

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Equipment Bulletins

Three bulletins describing (a) centrifugal refrigeration equipment, C-1100-B14; (b) equipment for refrigeration and air conditioning, WP-1099-B48; (c) construction and typical applications of vertical turbine pumps, H-450-B33.—*Worthington Pump and Machinery Corp., Harrison, N. J.*

Sealedpower Motors

A four-page bulletin describes the Sealedpower motor. The Sealedpower motor was developed for use in dusty locations, in places where there is excessive moisture, and for all applications where the conventional alternating-current, totally-enclosed, fan-cooled motor has been used in the past. It is available in sizes from 2 hp to 15 hp.—*Crocker-Wheeler Div., Joshua Hendy Iron Works, Ampere, N. J.*

Cooling Tower Equipment

A new 16-page bulletin covers spray nozzles for water cooling, air conditioning, and for general industrial use. —*Yarnall-Waring Co., Chestnut Hill, Philadelphia 18, Pa.*

Safety and Relief Valves

A line of safety and relief valves is described in the new catalog No. 45, issued by the Farris Engineering Co. Many new valve designs and improvements in old designs are included. A "ready-reference pictorial index chart" shows line drawings of all the basic Farris valve types. With this chart a valve user can pick out the valve he needs without having to thumb through a whole catalog. Directly opposite the pictorial index chart is a detailed index showing what the valve can be used for and where to find its specifications in the catalog.—*Farris Engineering Co., 400 Commercial Ave., Palisades Park, N. J.*

Arc Welding Accessories

A price list and catalog of Airco arc welding accessories has been published by Air Reduction. This 12-page booklet illustrates and describes a line of accessories for arc welding machines and operations. Types of equipment covered include: electrode holders, graphite electrodes, welding cable, cable connectors, and cable lugs. Also listed are: welding helmets, goggles, face shields, headgear, aprons, gloves, and sleeves. An additional section is devoted to Airco Heliwelding equipment which was developed for welding magnesium. Copies of this booklet may be obtained by writing for catalog No. 130.—*Air Reduction, 60 East 42nd St., New York 17, N. Y.*

Electric Motors

An 8-page, file-size, condensed catalog bulletin (printed in Spanish and Portuguese as well as English) presents specifications and descriptions of standard motors and generators made by Star and describes facilities for building special motors. Illustrations show many typical applications in hoists, comminutors, canning machinery, diesel generators, dry-cleaning machinery, printing equipment, machine tools, and other equipment in which severe service conditions are encountered. Specifications and load capacities are included for squirrel-cage induction motors ½ to 200 hp; wound-rotor induction motors ½ to 200 hp; direct current motors one to 200 hp; and design features of Star gearmotors and brakemotors.—*Star Electric Motor Co., 200 Bloomfield Ave., Bloomfield, N. J.*

Design of Piping Layouts

Conclusions of prefabricated power piping engineers regarding the design of piping layouts for flexibility have been published in a booklet entitled "Blaw-Knox Functional Spring Hangers and Vibration Eliminators." The booklet gives many details concerning standard and special types and sizes of functional spring hangers and vibration eliminators, with instructions for their installation, and engineering information which will be of help when adoption of this type of support is under consideration.—*Blaw-Knox Co., Pittsburgh, Pa.*

Valve Chart

A new Valve Renewable Parts Chart has been published by the Reading-Pratt & Cady Division of the American Chain & Cable Co., Inc. The chart gives pictures and data on brass and iron valves with vital parts that can be renewed. Briefly, the chart tells how to renew and replace worn out parts. It is 22" high by 28" wide and is printed in red and black on white dull coated stock. It can be tacked on the wall or filed for future reference.—*Reading-Pratt & Cady Division American Chain & Cable Co., Inc., Bridgeport 2, Conn.*

Selection of Arc Welding Electrodes

"Arc Welding Electrodes," a new 32-page illustrated catalog published by Wilson Welder & Metals Co., Inc., is designed to guide electrode users in the selection of the right electrodes for any specific job.

This catalog supplies complete data on the proper electrodes to be used for all types of work on a wide variety of base metals, and describes the approved welding procedures for each application, including the welding of galvanized sheet iron.—*Wilson Welder & Metals Co., 60 East 42nd St., New York 17, N. Y.*

Getting Personal

J. L. Strahan *(Heat and Ventilation in the Design of Dairy Barns*, page 81) taught agricultural engineering for a total of 13 years at Cornell University and the Massachusetts State College at Amherst. He was chief engineer for the Louden Machinery Co., Manufacturers of barn equipment, for 6 years. He was for nine years with the Farm Security Administration as agricultural

J. L. Strahan

engineer in the northeast region responsible for rehabilitation of physical facilities on farms purchased for FSA borrowers. At present he is agricultural engineer in charge of the Farm Engineering Department of the Flintkote Co.

Mr. Strahan is a fellow of the American Society of Agricultural Engineers and a contributor on farm structures subjects to annual proceedings. His principal interest has been in design and ventilation of animal shelter structures.

HEAT TRANSFER EQUIPMENT

PATTERSON-KELLEY
Heat Exchangers
AND
Process Equipment

for any system or operation requiring the transfer of heat to or from a liquid or gas, such as this cooler using Freon as the refrigerant.

COOLERS, heat-exchangers, waste heat reclaimers, evaporators, condensers . . . it is in the field of such heat transfer equipment that our engineers have served industry for years, specializing in the design and manufacture of many types for many diverse requirements.

When you have a problem involving heat transfer equipment, or when you are ready to place an order for such equipment, this group of heat transfer "specialists" is in a position to give you the best design for your requirements.

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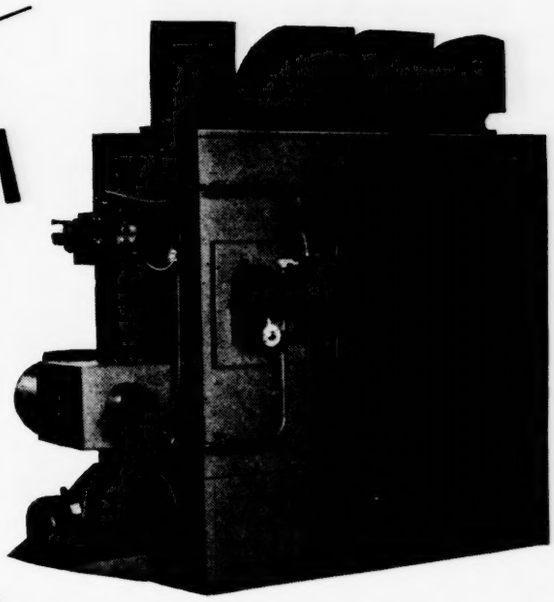
Provides More Efficient . . . More Economical Heat



THE new Airtherm Space Heater provides an even distribution of heat to all parts of the building through high velocity nozzles — is installed with a minimum of installation costs and requires practically no maintenance.

The new Airtherm Space Heater is available in 3 models — for floor mounting (as illustrated) or horizontal or vertical suspension. Choice of gas or oil burners on all models. Capacities from 650,000 to 1,950,000 BTU's per hour.

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. . . Since the Last Issue

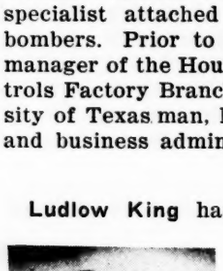
D. W. Russell, president of **Airtemp Division, Chrysler Corp.**, announced the appointment of **H. A. Malcom,** formerly assistant general sales manager, to the position of general sales manager. Mr. Malcom has been with Chrysler Airtemp for five years and has held several sales executive posts. He was regional sales supervisor in charge of the Southern half of all U. S. markets before he became assistant sales manager. As general sales manager, he will now administer the entire post-war sales program on Chrysler Airtemp's air conditioning, heating and refrigeration products. Prior to his association with Airtemp, Mr. Malcom held sales executive positions with nationally known manufacturers of large volume products, such as automobiles, electric refrigerators, and electrical appliances. He served in the U. S. Army in World War I.

H. A. Malcom

The National Radiator Co. has started construction of an extensive addition to its plant at New Castle, Pa. Of brick and steel construction, the building will add about 11,000 sq ft of floor space to existing facilities at New Castle, and with equipment will cost $235,000.

The appointment of **Robert C. Allen, Jr.** as manager of the Kansas City, Mo., factory branch was recently announced by **General Controls Co.**, Glendale, Cal. Mr. Allen will devote his entire time to serving users of automatic pressure, temperature and flow controls in Missouri, Kansas, Eastern Nebraska and Western Idaho. Mr. Allen was in the Army for 3½ years, spent 27 months overseas with the 9th Air Force as an electrical specialist attached to a squadron of B-26 Marauder bombers. Prior to joining the service, Mr. Allen was manager of the Houston and Dallas, Texas, General Controls Factory Branches for three years. He is a University of Texas man, having majored there in engineering and business administration.

Ludlow King has been appointed manager of the Washington, D. C., office of **Owens-Corning Fiberglas Corp.**, 1031 Investment Building. Mr. King recently retired from the Chemical Warfare Service in which he was commissioned a lieutenant colonel. He was wounded during the Normandy invasion while serving on the staff of 7th Corps Headquarters. During his three years in the U. S. Army, he was executive officer of the Material Command of the Chemical Warfare Service, supervising and coordinating work of the Technical, Industrial and Supply Divisions.



L. King

The appointment of **Clarence M. Allen** of the **Philip Carey Mfg. Co.** as branch manager of the St. Louis office was announced. Mr. Allen goes to his new position from Carey's Cleveland office where he was assistant branch manager.

Surface Combustion Corp., Toledo, Ohio, announces the appointment of **George D. Yeazel** as factory sales representative at Kansas City, Mo., with offices at 950 Dinks Building, of which Wallace Adams is district manager.

Change to larger quarters by **Western Thermal Equipment Co.**, manufacturers of Visoleak detection fluid for refrigerant systems, is announced by G. B. Bloom, President. Address of the new location is 1701 West Slauson Ave., Los Angeles 44, Cal. The new location provides additional space to consolidate office, factory, warehouse and shipping facilities in one location, and facilitate further expansion of the company. Production has been started on Visoleak charging sets, for injecting Visoleak or refrigerant oil into systems.

Completing a special assignment for the U. S. Government in Europe, **Dr. T. H. Troller,** developer and pioneer of the axial air flow principle, returns to his activities as consulting engineer of **The La-Del Fan Co.,** division of The La-Del Conveyor and Mfg. Co., New Philadelphia, Ohio. On leave from La-Del, Dr. Troller made a special study of the most recent aeronautical developments in Europe.

W. H. Hammond has been promoted to the newly created post of vice-president in charge of sales of **Gar Wood Industries, Inc.,** Detroit. Mr. Hammond was formerly sales manager of the hoist, body and tank divisions only and director of branches with the title of vice-president. In his new position, Mr. Hammond will supervise the sales activities of the winch and crane, road machinery, heating and boat divisions in addition to those formerly under him. He will continue as director of branches. Mr. Hammond joined Gar Wood as a bookkeeper in its Philadelphia branch in 1921, shortly after his discharge from the Army. He was named manager of the Baltimore branch in 1925 and of the Boston branch in 1929. He came to New York in 1933 to head Gar Wood's activities here and assumed the position he has just vacated in January, 1934.

W. H. Hammond

A. H. Witt has recently resigned as sales manager of **Drayer-Hanson,** Los Angeles refrigeration and air-conditioning manufacturers, to engage in business for himself under the firm name of "Witt Coils." The new organization will handle a complete line of commercial refrigeration coils and water coolers and will sell through jobbers only.

Wagner Electric Corp. announces the following changes in service branch personnel: **Forrest G. Wilson,** formerly a salesman at the Dallas branch, has been appointed manager of the Indianapolis branch. **H. F. Zahn,** formerly manager of the Atlanta branch, has been made manager of the Philadelphia branch. **C. G. Jackson,** formerly manager of the Boston Branch, has been moved to Atlanta to manage that branch. **J. K. Miller,** heretofore a New York branch salesman, has taken over the management of the Boston branch.

Robert M. Buck and **Robert A. Clark** have been added to the development staff of the newly-established Industrial Division of **Bryant Heater Company,** Cleveland, Ohio. Mr. Buck is a graduate of the University of Michigan. He was previously engaged in research and development work with the Michigan Consolidated Gas Company. Mr. Clark graduated from Syracuse University in 1926, when he joined the metallurgical department of Otis Steel Company. In 1942, Clark assumed the duties of steam efficiency and combustion engineer at the Lakeside Works of Jones & Laughlin Steel Corporation, Cleveland.

QUIET

PROPS mean QUIET PERFORMANCE

• When you use Meier Nu-Air Quiet Props you can be sure of quiet, efficient performance in your ventilating equipment.

Accurately static-balanced, insulated blades with plated spider make these much desired features possible.

Available in sizes 10" to 54" and from 11° to 34° pitch.

For technical data, write for Bulletin No. 2100.

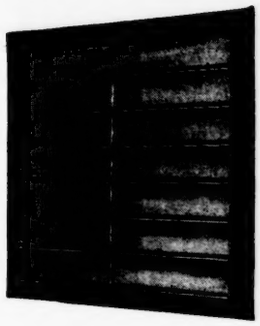
Produced under license from The Torrington Manufacturing Company.

MEIER ELECTRIC & MACHINE CO.
3525 E. WASHINGTON STREET
INDIANAPOLIS 7, INDIANA

Meier Nu-air Quiet PROPS

Elgo Ventilating Specialties

AUTOMATIC SHUTTERS with MANY EXCLUSIVE FEATURES



"ELGO" TYPE AUTOMATIC SHUTTER Front View (Closed)

Louvres weatherstripped on inner edge, instead of on outer edge, making the unit the tightest closing shutter on the market.

Swivel-joint with special shoulder rivet. No wear or rattle. Good for the life of the shutter.

More sensitive than any other automatic shutter, and longer lasting. Sizes from 10" to 60" square—also rectangular.

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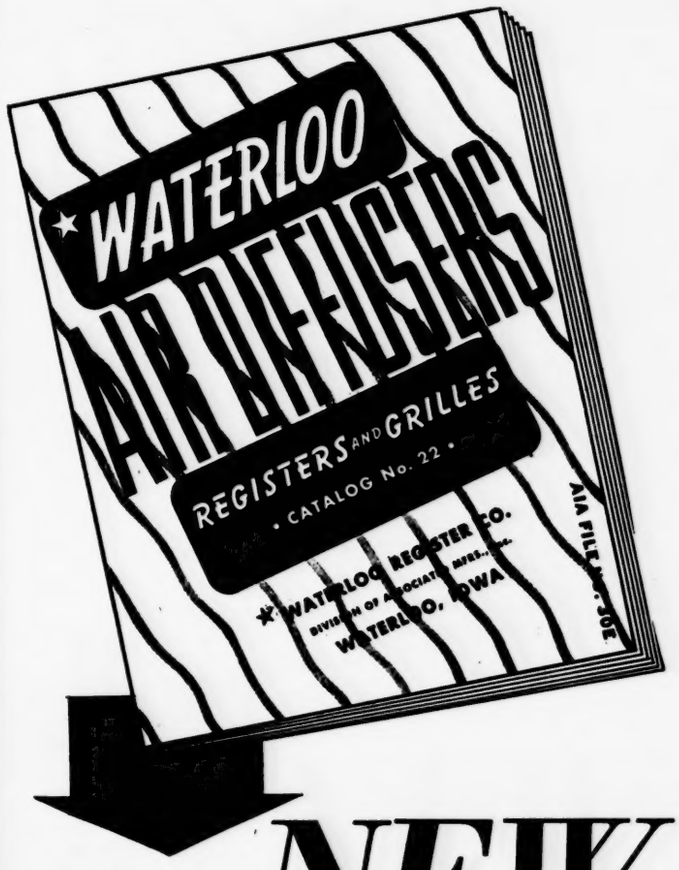
Automatic Shutters **Ceiling Dampers**
Balanced Vent Units **Motorized Shutters**
Hand Operated Shutters

Free Catalog

ELGO SHUTTER & MFG. CO.
6968 W. JEFFERSON DETROIT 17, MICH.



IT'S NEW

. . . AND YOUR COPY IS WAITING

Send today for this complete catalog and price list—it's up-to-the-minute and complete—gives every detail and fully describes Waterloo Registers and Grilles.

Also includes simplified grille selection data—so you can quickly determine grille sizes for supply and return openings. Now don't forget—but write *right away* for your free copy.

WATERLOO REGISTER DIVISION

ASSOCIATED MANUFACTURERS, INC.

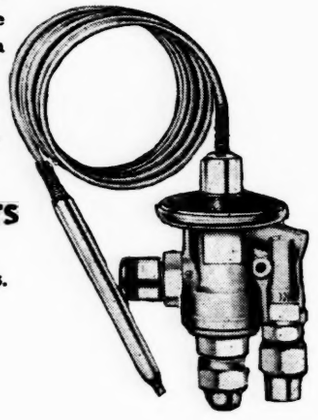
WATERLOO, IOWA

"FRACTIONAL TONNAGE
VALVES FIT LOW
TEMPERATURE WORK
WITHOUT HUNTING
OR STARVING...!"
REFRIGERATION MAINTENANCE CO.
We use and like A-P Valves especially on low temperature work. We like the fractional tonnage sizes because we can better fit the job without hunting or starving.
Yours very truly,
A. L. Robertson

EXPERIENCED REFRIGERATION SERVICE

Engineers like Mr. A. L. Robertson, of the Refrigeration Maintenance Co., Madison, Wis., give full credit to "A-P Dependable" Refrigerant Valves for their special adaptation to low temperature work. They find that "A-P" fractional tonnage sizes for Freon or Methyl Chloride refrigerant applications make it easier, as Mr. Robertson states, to fit the job without necessity of "hunting" or "starving" the line.

Offering a wide range of adaptability, any standard A-P Refrigerant Valve can be used on air conditioning, commercial temperature and low temperature work without special adjustment or without changing valves. Thus, one standard A-P Valve fits a variety of applications.



Write for Illustrated Bulletins covering A-P Refrigerant Valves

AUTOMATIC PRODUCTS COMPANY
2462 N. 32nd St., Milwaukee 10, Wis.
Export Dept., 13 E. 40th St.
New York 16, N. Y.

DEPENDABLE *Refrigerant Valves*

A-P Model 205 Thermostater Expansion Valve. Capacity up to 1 ton Freon.

Stocked and Sold by Good Refrigeration Jobbers Everywhere—
Recommended and Installed by Leading Refrigeration Service Engineers

The first official postwar order for overseas shipment received by **Utility Appliance Corp.**, Los Angeles, recently, marked the resumption of the firm's extensive prewar export program. Perry Girton, owner of the Costa Rica Broadcasting Company and radio station GIPG, San Jose, Costa Rica, placed a substantial order for Utility blowers and fans. His firm distributes well known major appliances throughout the Central American republic. Another account which was among the first to return was Bruce & Company, Honolulu distributing firm. Allen E. Bruce, president, placed an order for blowers and fans to be distributed in the Hawaiian Islands.

Election of four vice-presidents of the **Minneapolis-Honeywell Regulator Co.**, establishment of two new executive posts and changes in the sales and production divisions were announced by Harold W. Sweatt, company president.

The new vice-presidents are **Paul B. Wishart,** in charge of factory operations in Minneapolis; **Arthur H. Lockrae,** in charge of the heating controls department; **John E. Haines,** in charge of the commercial controls department, and **C. D. Lyford,** who will be in charge of sales to the gas industry, Mr. Sweatt said.

C. D. Lyford

J. E. Haines

The board of directors of the company have also elected **C. B. Sweatt** and **W. L. Huff** to the new positions of executive vice-president, giving each authority to act in executive capacity with respect to any of the company's divisions or activities, thus giving official recognition to a policy which has been in general practice. Mr. Huff will also continue as treasurer of the company.

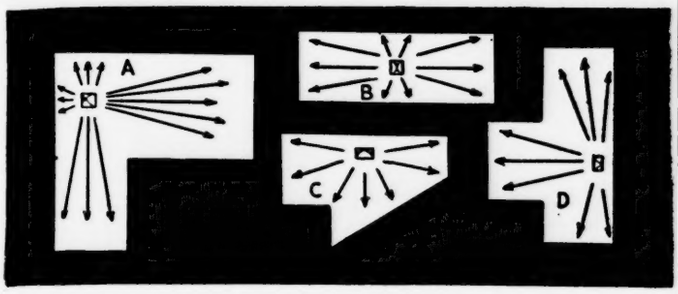
James H. Binger was elected assistant secretary and will assume the duties of W. F. Marquart who is retiring from that position to return to law practice, the announcement stated.

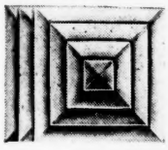
A. H. Lockrae

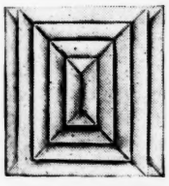
P. B. Wishart

Other changes in company management include the appointment of **Thomas McDonald** as vice-president in charge of sales. Mr. McDonald, who has been vice-president in charge of Honeywell's aeronautical controls plant in Chicago, will assume direct responsibilities for those activities formerly supervised by C. B. Sweatt. **Alfred M. Wilson,** also a vice-president, will be in charge of all company activities in connection with aeronautical controls and will coordinate development, manufacturing and sales operations of this division with other divisions of the company.

WHAT DIFFUSERS FOR THESE AREAS?







AGITAIR TYPE R AIR DIFFUSERS
FOR DIFFUSION PATTERN CONTROL

Perfect diffusion of air into all parts of odd-shaped rooms is available only with Agitair Type R Air Diffusers. And you don't need to mount type R in the center of the space.

That's because Agitair Type R, assembled from standard parts to any pattern desired, can divide the incoming air into one, two, three, or four streams, and diffuse these streams into the room in exact proportion to the areas they serve. Temperature differential and duct velocity are dissipated rapidly, noiselessly, draftlessly. Get the facts from Air Devices, Inc.

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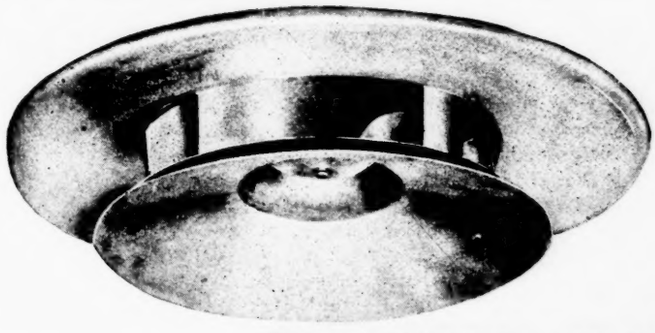
DEMUTH
Draftless
AIR DISTRIBUTOR . . . .



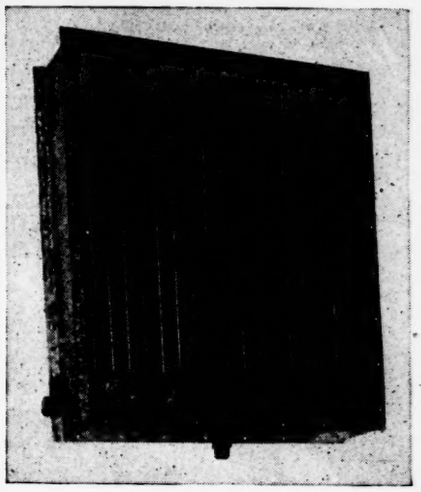
The only Distributor with the patented curved-vane construction which imparts a circulator motion to the air . . . the Distributor which effectively mixes room air with conditioned air . . . the Distributor which speedily establishes a uniform temperature WITHOUT DRAFT!

Quick Deliveries of STAINLESS STEEL ALUMINUM GALVANIZED IRON OR ENAMELED AIR DISTRIBUTORS

CHARLES DEMUTH & SONS
MINEOLA (LONG ISLAND), N. Y.

COILS
FABRICATED TO SIZE

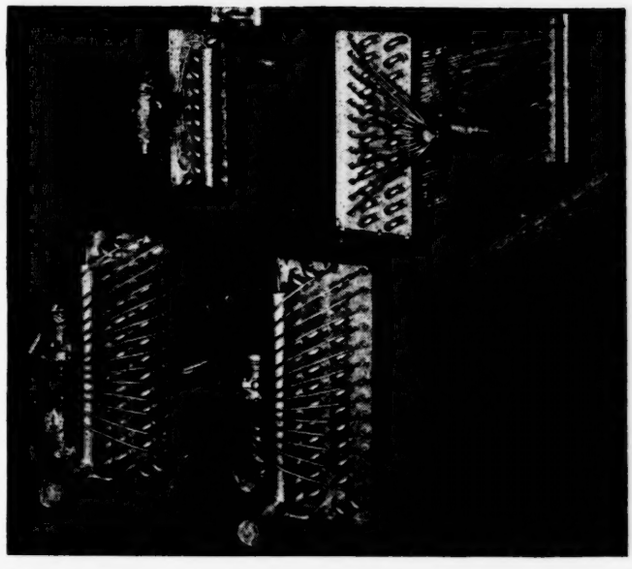
All Monsoon coils can be fabricated to specification in any size or shape for early delivery.



MONSOON HEATING COILS – Two header and non-freeze types with inner tube steam feed. Extended surface coils permit high rate of heat transfer and remarkably low resistance to airflow. Available in a wide variety of sizes for prompt delivery.

TYPHOON Products

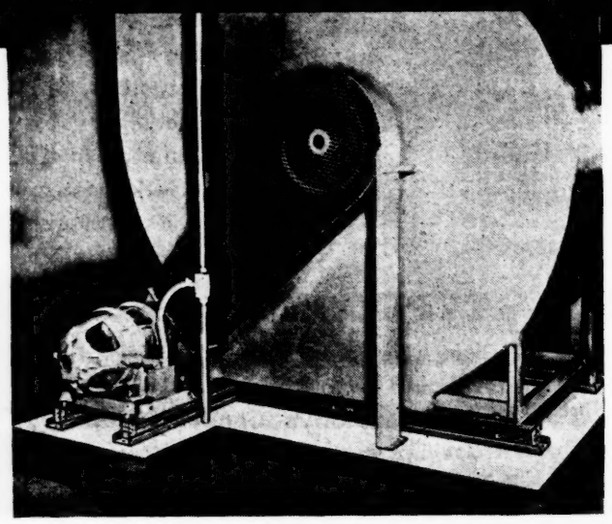
- Prop-R-Temp Self-Contained Air Conditioning Units, 3 and 5 tons
- **Typhoon** Evaporative Condensers
- **Typhoon** Spray Coolers (Air Washers)
- Prop-R-Temp Air Conditioning Units
- Monsoon Heating Coils (2-Header and Non-Freeze Types)
- Monsoon Direct Expansion Coils
- Monsoon Water Coils (Continuous Tube and Free Drain Types)



MONSOON DIRECT EXPANSION COILS AND COILS FOR WATER COOLING—Available in a wide range of sizes with circuits designed to provide for even distribution of liquid. Prompt delivery.

ICE-AIR CONDITIONING CO., INC.
794-6 Union Street • Brooklyn 15, N. Y.

ISOLATE
VIBRATION AND NOISE
from
FANS AND BLOWERS



Typical installation of fan and motor on Korfund isolating fan base.

KORFUND TWIN RAIL FAN BASE is a development in fan and blower isolation to assure efficient isolation of noise and vibration at an unusually low cost.

Interchangeable prefabricated parts are used throughout. It is light in weight, yet has great rigidity to vertical and lateral stresses. The Twin Rail Base is easily assembled and installed. Caps designed to hold fan and motor housings are securely clamped, yet can be repositioned by unlocking a single nut. Isolators provide uniform loading and can also be repositioned to compensate for unequal weight distribution.

Write for Bulletin TR-800 for further information on Korfund Twin Rail Fan Base.

KORFUND
VIBRATION CONTROL
THE KORFUND COMPANY, Inc., 48-33 32nd ST., LONG ISLAND CITY 1, NEW YORK

Harvey-Whipple, Inc., announces the appointment of **W. Howard Holcomb** of Providence, Rhode Island as Master Kraft factory representative covering the states of Maine, New Hampshire, eastern Massachusetts, and Rhode Island. Mr. Holcomb has been associated with the oil burner industry since 1920 and has covered the New England territory at various times for well known manufacturers.

Yarnall-Waring Co., Philadelphia, announces the following personnel changes; at home office and factory, **Joseph Kildare** has been appointed sales manager; **Frank W. Miller** has been made works manager and **J. Frank Long** has been transferred to Chicago district office as sales engineer. **Charles H. Grosjean,** sales engineer in New York office, is now in charge of Detroit sales office, replacing **C. N. Maxfield,** who has been appointed California district manager, with new sales offices in San Francisco and Los Angeles. Two new men have been added to Yarway sales staff; **Jackson Kemper,** New York office and **Jack Schuyler,** Los Angeles office; both of these sales engineers have had long experience in selling and servicing steam plant equipment.

The **Iron Fireman Mfg. Co.** has announced the appointment of **A. M. Stephenson** and **A. Bayes Jordan** as district representatives in the southern territory. **A. M. Stephenson,** an engineer in the Cleveland service department of Iron Fireman since early 1942, now is district representative with headquarters in Charlotte, N. C. He entered the Iron Fireman factory organization in 1937 as a field engineer operating out of Terre Haute, Ind., and held this post until his transfer to the engineering department in Cleveland.

A. M. Stephenson

A. B. Jordan

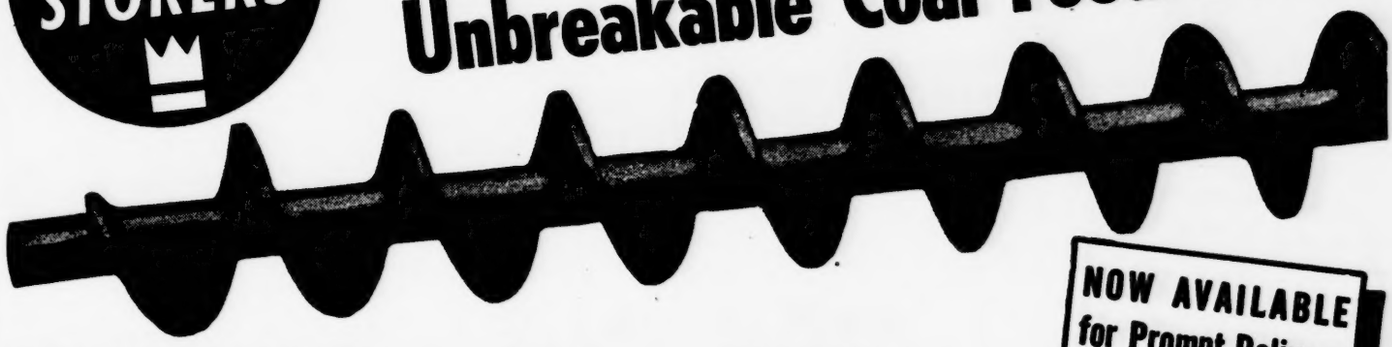
Taking the place of S. W. Alford, southern division district representative who has been promoted to district sales manager, is A. Bayes Jordan. Mr. Jordan has had several years of experience with a large southern utility and more recently as industrial sales engineer for a leading producer of insulation material. He now has his headquarters in Cleveland, Tenn.

The **Anthracite Industries, Inc.,** announced the return of **William J. Cusack** and **Mark G. Sandford** to their former duties as field representatives. They had been on leave of absence from AI, Inc., to the Solid Fuels Administration for war. Mr. Cusack has returned to his old territory, Western New York, with headquarters in Buffalo, and Mr. Sandford is back covering Connecticut, with headquarters in Milford, Conn.

H. H. Hackett, Sr. is now a Pennsylvania district representative for Oil-O-Matic, according to an announcement by W. A. Matheson, vice-president in charge of the **Williams Oil-O-Matic Division, Eureka Vacuum Cleaner Co.** Mr. Hackett comes with Oil-O-Matic from the Reconstruction Finance Corporation office in Philadelphia where he served as an examiner of surplus war materials from January, 1945 to September 1, 1945. His oil burner experience started in 1922, with the Willner Burner Mfg. Co., of Philadelphia.

For STOKERS

The CROWN Unbreakable Coal Feed Screw



NOW AVAILABLE for Prompt Delivery

WELDED All-Steel Worm—All Sizes—All Pitches

★Crown's complete line of all-steel Coal Feed Screws meets every replacement and production requirement. Produced for both domestic and industrial stokers. Crown Screws are available with right or left hand screw, in all sizes and pitches, tapered or straight, and in combinations of pitches. Uniformly smooth surfaces insure that coal will flow freely and easily through the flights. Because it is all-steel with continuous weld, the Crown Coal Feed Screw guarantees long, continuous operation with full customer satisfaction. Crown is in a position to make prompt delivery on all sizes.

In ordering give complete specifications on size and design.

CROWN IRON WORKS COMPANY

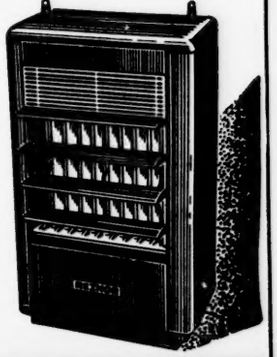
1207 Tyler St., N. E. *Since 1878* Minneapolis, Minn.

"Yes. *Heat where you want it—*"

REZNOR

Gas unit heaters

1. Suspended—saves floor space.
2. Gas fired—clean, automatic heat.
3. Attractive—seal brown.
4. Will heat any size area.
5. For commercial and industrial buildings.
6. Easily installed.



★

Propeller fan and blower types. Nine sizes of each.

REZNOR MANUFACTURING CO.

Since 1888

MERCER, PENNA.

NO BOILERS • NO STEAM LINES
NO FUEL STORAGE • NO FIRE TENDING

Conseco 15 ton freon heat exchanger, Strand Theatre, N. Y.

Air Conditioning HEAT EXCHANGERS

CONSECO

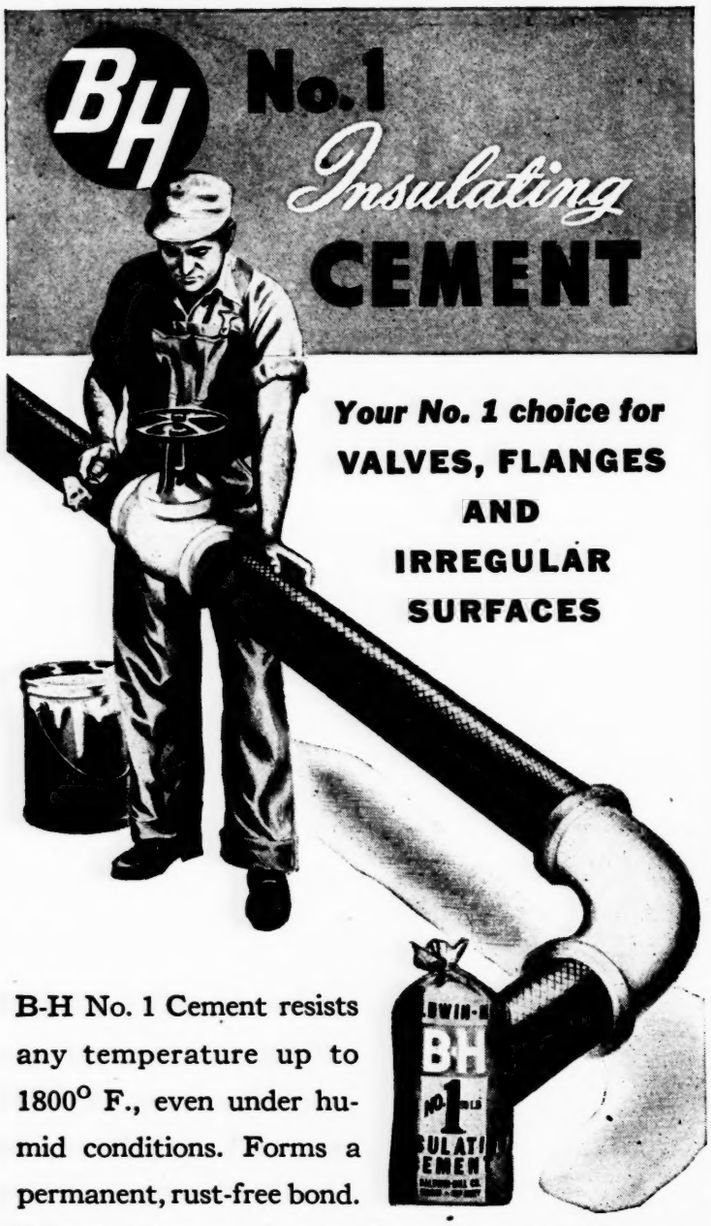
Let our engineering department help you with your problem

Twenty years' specialized experience designing, fabricating and servicing heat exchangers assure sound design, quality construction and economical operation with any type refrigerant. Engineering assistance gladly furnished. Write.

SERVICE

CONDENSER SERVICE & ENGINEERING CO., INC.

63 RIVER STREET, HOBOKEN, N. J. • *Phone Any Time*



B-H No. 1 Cement resists any temperature up to 1800° F., even under humid conditions. Forms a permanent, rust-free bond. Withstands normal expansion and contraction—no peeling, no cracking.

B-H No. 1 Cement is easily applied—just mix with water and trowel on. Assures a neat, workmanlike job even on irregular surfaces, large or small. Keeps costs down—gives exceptional coverage—completely reclaimable up to 1200° F.

JOBBERS are preparing to supply this easily-applied, cost-reducing product. It will pay you to investigate. Baldwin-Hill Co., 548 Klagg Avenue, Trenton 2, N. J.

Baldwin-Hill

BH **SPECIALISTS IN**

THERMAL INSULATION PRODUCTS

Paul Peckar, formerly Assistant Senior Division Engineer of the Reconstruction Finance Corporation, has joined the engineering staff of **Tenney Engineering, Inc.,** 26 Avenue B, Newark 5, N. J., manufacturers of automatic temperature, humidity, and pressure control equipment.

The appointment of **J. J. Smiley, Jr.** as assistant advertising manager of the **Philip Carey Mfg. Co.,** Lockland, Cincinnati, Ohio, was announced by Harold D. Bates, advertising manager. Mr. Smiley, who is a captain in the reserves, joined the Carey organization August first this year when he returned to inactive status after serving three and a half years with the Quartermaster Corps of the Army. He served in the E. T. O. for 19 months and was awarded the Bronze Star medal prior to his return to the United States. Before entering the Army, Mr. Smiley was engaged in the building materials field first as a sales representative and later as the owner of his own building material and coal company in Frankfort, Michigan.

Syracuse University, Syracuse, New York, will hold its first short course, according to present plans, beginning on April 15, 1946. The course will extend over a three or four day period and it will cover a course of instruction on gravity warm air heating and winter air conditioning systems.

Arley L. Baker has been appointed assistant sales manager of the **Alco Valve Co.,** St. Louis manufacturers of refrigerant control valves. Formerly application engineer for the company, he will continue to devote most of his time to the field work in which he has a wide and varied refrigeration background. Mr. Baker came to Alco more than a year ago from Curtis Manufacturing Co., where he had been district representative of the north central territory since 1939. Previous to that time, from 1930 until 1939, he was a partner in the Machinery Service Company, St. Louis. His first position after leaving the University of Illinois, where he studied engineering, was with Midcontinent Equipment and Machinery Co., also of St. Louis.

A. L. Baker

The **Power Piping Division** of the **Blaw-Knox Co.** announces the appointment of **Flagg, Brackett and Durgin,** of Boston, Mass., as sales representatives in the following five New England states: Massachusetts, Maine, New Hampshire, Vermont, and Rhode Island.

Bryant Heater Co., Cleveland, Ohio, one of the operating companies of Dresser Industries, Inc., will manufacture water heaters, floor and sidewall furnaces, and unit heaters in a plant now being built in Tyler, Texas, it was announced by Lyle C. Harvey, President of Bryant. The plant, which is to cover 110,000 square feet, is due to be completed shortly after the first of the year and will employ between 150 and 250 men. The first products to be made in Tyler will be water heaters of both Bryant and Day and Night models. Next will follow panel heaters of Bryant and Day and Night make, and floor furnaces as designed by Bryant and by Payne Furnace Company, another Dresser Company. When in full operation, the plant will also make unit heaters of Bryant and Payne furnace design.

H. B. Lammers, power supervisor of the Wright Aeronautical Corp. at Cincinnati, was appointed director of engineering of the **Coal Producers' Committee for Smoke Abatement,** effective January 1, 1946. This selection was made by the executive committee of the group, according to an announcement by R. E. Howe, Chairman.

PREHEAT FOR PROPER HEAT

WHITLOCK FUEL OIL HEATERS

The Whitlock Type V-1 Oil Heater shown above is of a simple standard design at moderate cost. These units in all-welded construction, adapted to high working pressures, are *immediately available from stock.*

Whitlock Fuel Oil Heaters of more elaborate design are made to suit individual operating conditions and engineered for any combinations of temperature rise, operating pressure and capacity. Incorporating Whitlock's experience of many years in the fabricating of such equipment, they guarantee a unit to suit your requirements for economy and efficiency.

Our engineers will gladly discuss your fuel oil heating problems and make specific recommendations. Write for new Bulletin No. 35 describing and illustrating the complete line of Whitlock Fuel Oil Heaters.

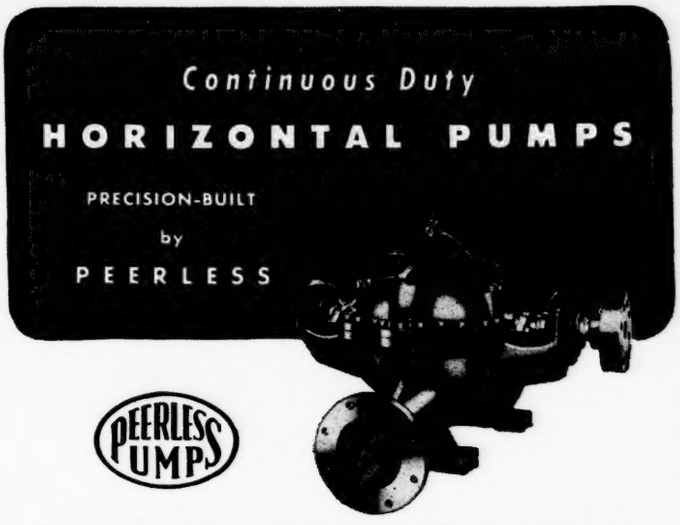
The WHITLOCK MANUFACTURING COMPANY

40 South Street, Elmwood, Hartford 1, Conn.

NEW YORK BOSTON CHICAGO PHILADELPHIA DETROIT RICHMOND

Authorized representatives in other principal cities.
In Canada: Darling Brothers, Ltd., Montreal

Established 1891—Ahead of the Times for Half a Century.



Peerless *(formerly Dayton-Dowd)* Horizontal Centrifugal split case or solid volute pumps, single and multi-stage are found wherever reliability, dependability and economical operating are desired. Engineered and manufactured with a view to long life, Peerless Horizontal Pumps are available for all classes of pumping requirements for high or low heads. The complete line of Peerless Deep Well Turbine, Hi-Lift, Hydro-Foil (propeller), Sewage, and Household pumps are standard for all Vertical pumping conditions.

The right pump for the right job. All inquiries and specifications processed by trained engineers.

PEERLESS PUMPS

PEERLESS PUMP DIVISION
Food Machinery Corp.

FACTORIES
LOS ANGELES 31, CALIFORNIA
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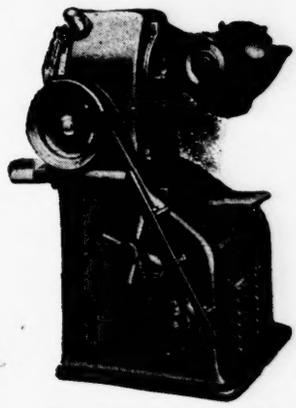
BEHIND THE SCENE

there's a Torrington Air Impeller

HIGH SPEED MACHINE TOOLS UTILIZE FORCED AIR FOR COOLING

Modern machine tools using hydraulic systems or liquid coolants are another field in which the application of Torrington Air Impellers is proving beneficial. Higher operating efficiency and longer life result from the use of Torrington Airistocrat propeller fan blades and Airotor blower wheels in this important field.

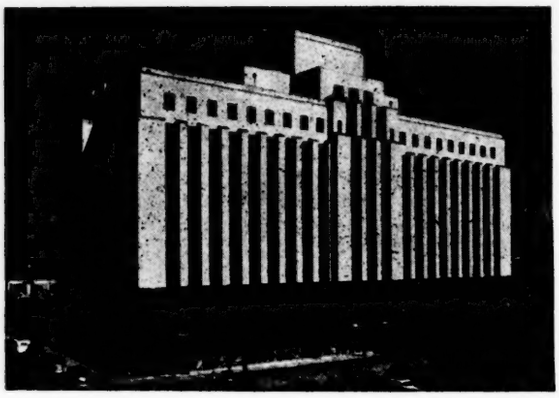


An automatic precision nut tapping machine, with a Torrington fan for cooling.

Use our Air Impeller Specification Sheet for a preliminary appraisal of your air impelling needs, for any type of product. Then submit the data for the recommendation of our experienced engineering staff.

THE **TORRINGTON**

MANUFACTURING COMPANY, TORRINGTON, CONN.



The Bankers Life Building, Des Moines, is Air Conditioned Throughout with Frick Refrigeration.

In Notable Buildings—

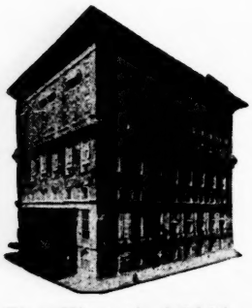
FRICK TRADE MARK

Refrigeration

The Philtower and Philcade Buildings at Tulsa are Air Conditioned with 1000 Tons of Frick Refrigeration.

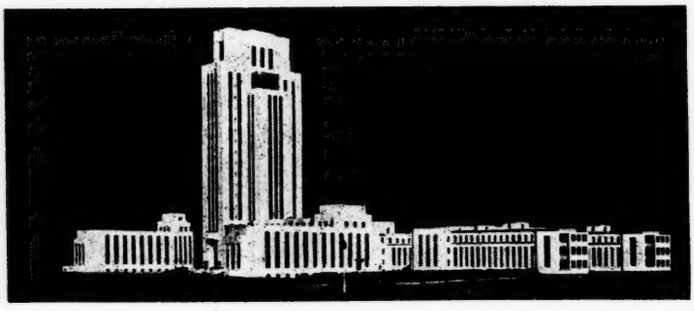
Provides half a dozen profitable services: conditioning air, cooling drinking water, dispensing beverages, making ice, freezing ice cream, and holding desired temperatures in any number of rooms and boxes—for furs, serums, flowers, candy, fruits, vegetables, meat, fish, poultry, dairy products, frozen foods, etc.

If the buildings in which you are interested need any of these cooling services, get in touch with your nearest Frick Branch or Distributor. Literature and estimates, cheerfully furnished.



The Missouri Athletic Asso., St. Louis, Uses 357 Tons of Frick Refrigeration for Air Conditioning, Ice Making, and Food Service.

FRICK COMPANY
Waynesboro, Penna.



The Naval Medical Center at Bethesda, Md., has a Dozen Rooms Cooled with Frick Refrigeration, which also Supplies Cold Drinking Water and Air Conditioning.

C. W. Hudzietz, well known refrigeration sales representative, has been placed in charge of an eastern outlet for products manufactured by the **Henry Valve Co.** of Chicago. Offices are located at 5618 Grand Central Terminal, New York City. No stocks will be carried at this eastern address as adequate stocks are now maintained by leading refrigeration jobbers in all important cities.

C. W. Hudzietz

A $3,500,000 expansion program involving additions to plants and machinery in four United States and Canadian cities was announced by **Minneapolis-Honeywell Regulator Co.** Needed to handle expanding sales in all company divisions, the new program follows purchase of a ten-story Minneapolis factory and the addition of four floors to the main plant during the war years. Included in the program is the construction of a new wing to the main plant in Minneapolis which will add approximately 120,000 sq ft to current facilities. Facilities in Chicago, Toronto and Philadelphia also will be enlarged either by the purchase of existing buildings or the addition of floor space to current structures. Building program will be started immediately.

Starting January 1st, the Fan Section of the **National Electrical Manufacturers Association** launched an educational program on the use and functions of electric fans. A nationwide information service, through the trade press and consumer publications, will explain how to get the greatest benefit from the many types of portable fans and fixed fans now in service.

Herman Nelson Corp. announces the return of **Comdr. Woodworth N. Murray** and **Major John A. Finnerty** as managers of the Boston and New York branch offices, respectively, and **Lt. Comdr. William J. Killian** as product application engineer in the Cincinnati branch office.

Stewart E. Lauer, president of **York Corp.,** announced the election by the board of directors of **John R. Hertzler** as vice-president. Mr. Hertzler, who was graduated from Lehigh University in 1927 with a B.S. degree in mechanical engineering, has spent his entire business career with York Corporation. In 1942 Mr. Hertzler accepted a commission in the United States Navy and held the rank of lieutenant-commander when he was recently released to inactive duty.

George D. Shaeffer, formerly chief engineer of **Gar Wood Industries, Inc.,** has been elected to the post of vice-president in charge of engineering, it was announced by Glen A. Bassett, president. Mr. Shaeffer joined Gar Wood in 1938 as chief engineer of its road machinery division, after having served as chief of the road machinery engineering department for Allis-Chalmers Manufacturing Co. for two years. On his graduation from Ohio Northern University in 1921, Mr. Shaeffer served with the Fate Root Heath Co. designing industrial locomotives. He became chief engineer of the road machinery division of W. A. Riddell Company in 1924, and remained with the company until he joined Allis-Chalmers in 1936.

G. D. Shaeffer

Heavy Duty

PERMANENT *Industrial Filters*

FOR IMPROVED AIR FILTERING
— GREATER CAPACITY —
LOWER MAINTENANCE COSTS

SPECIALLY DESIGNED for extra heavy duty and industrial air cleaning services, BADGER Heavy Duty Permanent Filters assure improved air filtering, lower air resistance, greater dust-holding capacity, while definitely reducing costs of maintenance. In addition, longer filter life is a certainty. Available in 2" and 4" sizes.

WRITE FOR CATALOG AND PRICES

Badger Corporation

331 E. Brown Street, Milwaukee 12, Wisc.

Money going up the flue?

MAKE YOUR OWN CO_2 TEST

You can get an accurate CO_2 reading in 30 seconds—and in 3 or 4 minutes a complete analysis including draft and flue gas temperature, by this handy, accurate Hays Combustion Test Set.

Reveals efficiency of combustion—tells how much money is going up the flue.

A new booklet "ABC of CO_2" is important reading — permits you to figure actual fuel loss. Write for it.

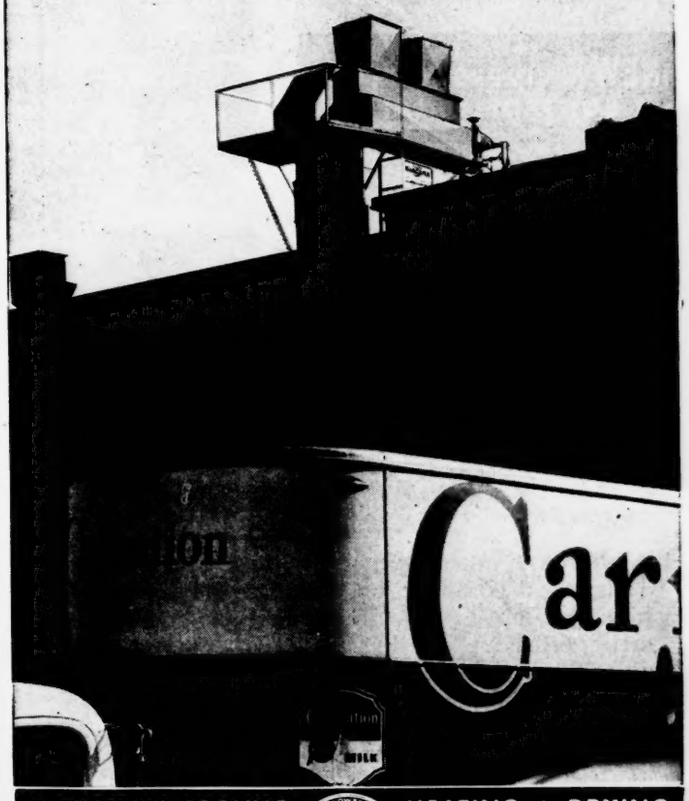
The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

Your Present Compressor Can Carry the Load for Greater Production!

You can increase your output of refrigerated products without adding new compressors. Extra capacity is already there, if you will install a NIAGARA Duo-Pass AERO CONDENSER.

Your gain in capacity will be permanent because the Niagara Duo-Pass takes the super-heat out of the refrigerant gas and reduces the condensing temperature so that condenser tubes are not clogged with scale. The experience of many users proves these advantages. Saving condenser water quickly repays the installation cost. Write today for Niagara Bulletin 91 for complete information.

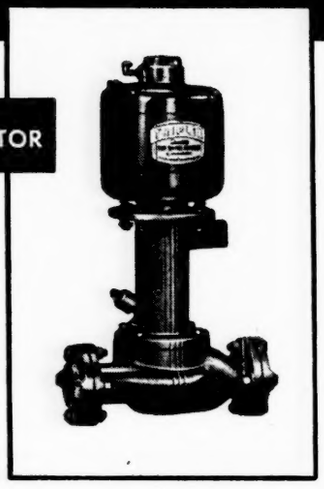
NIAGARA BLOWER COMPANY
Over 30 Years Service in Industrial Air Engineering
Dept. HV-16 6 E. 45th St., New York 17, N. Y.
Field Engineering Offices in Principal Cities



INDUSTRIAL COOLING • HEATING • DRYING
NIAGARA
HUMIDIFYING • AIR ENGINEERING EQUIPMENT

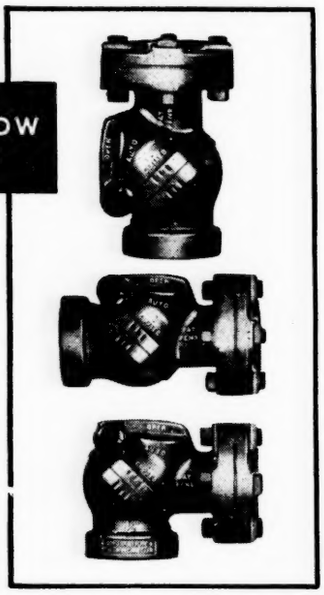
TWO MORE STEPS AHEAD by Triplex

NEW VERTICAL CIRCULATOR



—of modern streamline design. Precision gauge construction for smooth, dependable operation. Close fit of balanced inlet impeller in body bore assures unusually high pumping efficiency. Spring-mounted vertical sleeve bearing motor with automatic reset overload relay. Electrical knockout box prevents noises. All parts interchangeable with those of similar model and number. In 1", 1¼", 1½", and 2" pipe sizes (horizontal model for 2½" and 3" sizes).

NEW UNIVERSAL FLOW CONTROL VALVES



One stock meets all needs. Here's why: Valve seat and cover casting are divided at 45° angle—and assembled in line for use on horizontal or vertical mains, or at 90° for angle pattern installation. Four socket-head cap screws (easily removed for angle change) seal gasketed surfaces. Dependable valve mechanism (brass seat and closure cover) attached to external control knob. Complete units are of precision gauge construction and styled for modern eye appeal. In 1", 1¼", 1½", 2", and 3" iron pipe sizes.

With these outstanding new items of advanced design and construction added to its dependable standard line, Triplex offers precision-made equipment necessary to meet modern demands—and gives further assurance of hot water heating at its best! Write today for facts and prices.

DISTRIBUTED THROUGH RECOGNIZED WHOLESALERS

Triplex HEATING SPECIALTY CO.
PERU, INDIANA

Appointment of **Charles W. Stewart** as vice-president in charge of sales, is announced by **The Clark Mfg. Co.** of Cleveland, Ohio, manufacturers of steam specialties and fluid controls. Mr. Stewart has served as President of the Steam Heating Equipment Manufacturers' Association since 1942 and has been a member of the ASHVE since 1919. For the past 19 years Mr. Stewart has been associated with the Hoffman Specialty Company of Indianapolis—as zone manager, assistant general sales manager and, more recently, as vice-president in charge of sales. He was also a director of the company. In his connection with The Clark Manufacturing Co. Mr. Stewart will work closely with Vice-President John L. Mainwaring in extending the sales and distribution of the company's products nationally.

Mr. Mainwaring, while continuing his many contacts with the sales force and distribution system, will devote an increasing amount of his attention to engineering research, and to product development and application.

At a meeting of the board of directors of **Petroleum Heat and Power Co., Kenneth G. MacCart** was elected president of that company and its subsidiaries, succeeding **Wm. C. McTarnahan** who assumed the office of chairman of the board of directors. **James D. Burnes,** former assistant treasurer, was appointed treasurer and elected a member of the board of directors. **Wm. A. Bulger,** chief engineer of the company for over 15 years, was appointed vice-president in charge of manufacturing.

K. G. MacCart

Mr. MacCart completed his education at Massachusetts Institute of Technology and prior to joining the Petro organization in 1932 was associated with several large well-known organizations dealing in petroleum products. Mr. MacCart was elected assistant treasurer of Petroleum Heat and Power Co. in 1939, became treasurer in 1940 and was elected vice-president and treasurer and a director of the company in 1942.

Extension of the coverage of ACRMA equipment standards, a broadening of the scope of the association's statistical activities, and the adoption of a public relations program basically planned to benefit all phases of the air conditioning and refrigeration industry, were highlights at the fall meetings of the **Air Conditioning and Refrigerating Machinery Association** and its board of directors, held at Hershey, Pa.

Change in the name of the Association of Gas Appliance and Equipment Manufacturers to **Gas Appliance Manufacturers Association** was announced by Mr. H. Leigh Whitelaw, Managing Director. Functions of the Association will in no way be altered. The change of name is for the purpose of simplification only. Membership in the Association totals 296 manufacturers of gas appliances and equipment, who represent approximately 80 per cent of the total volume of such equipment manufactured in the United States and Canada. Purpose of the Association is to promote the use and sale of appliances and equipment used in the production, distribution, and utilization of gas as a fuel. **Harold Massey** has been appointed Assistant Managing Director of the Gas Appliance Manufacturers Association, Mr. White'aw announced.

The Kennard Corp. reports the opening of its new plant at 2019 So. Hanley Rd., St. Louis, Mo. The firm specializes in the manufacture of air conditioning blower units; refrigeration blower units; air conditioning coils; heating coils and similar products engineered to special requirements.

Jim Donnelly, formerly sales manager of Smithway gas water heaters, has been appointed product supervisor of the entire water heater division of the **A. O. Smith Corp. J. E. Woodall** resigned from this post November 15, because of ill health. Mr. Donnelly's appointment follows a long association with the water heater, plumbing and heating, and utility fields.

John Roland of Indianapolis, has recently joined the engineering department of **Conco Engineering Works,** Mendota. This was announced by Walter Sormane, General Sales Manager of Conco. John Roland recently resigned as chief engineer of the Stokol Division of Chrysler Air-Temp. Mr. Roland held this position with Stokol for many years while the Stokol Division was under the ownership of Schwitzer-Cummins Company of Indianapolis. He has been identified with the stoker industry since 1932 and has been active in engineering circles, on the engineering committees of Stoker Manufacturers Association, and is a member of the ASHVE. and of the Society of Mechanical Engineers. Conco is presently manufacturing a full line of stokers for domestic, commercial and industrial applications, also a complete line of oil and gas fired winter air conditioners and conversion burners, in addition to steel furnaces for coal and stoker firing.

Lewis A. Rodert, pioneer and principal American exponent of heat anti-icing systems for aircraft, has joined the research staff of **Stewart-Warner Corp.** at Indianapolis. Mr. Rodert comes to Stewart-Warner from the Ames Aeronautical laboratory of the National Advisory Committee for Aeronautics at Moffett Field, California, where he was section head of flight engineering. Previously he had been with the NACA at Langley Field, Va., in the flight research maneuver section. In 1942 Rodert founded the Ice Research base at Minneapolis, where he headed a program of research involving the testing of different types of aircraft in flight through natural conditions of icing. These tests resulted in numerous improvements and changes in aircraft design, both military and civilian. Mr. Rodert continues as a member of the NACA subcommittees on heat exchangers and de-icing problems.

The **Ice Air Conditioning Co., Inc.,** 252 West 26th St., New York City, manufacturers of Monsoon Coils and Typhoon equipment, announces the removal of its factory and executive offices to 794-6 Union Street, Brooklyn 15, New York. Particular emphasis will be placed on the manufacture of Monsoon Coils to specification in the enlarged factory.

Surface Combustion Corp., Toledo, O., announces that the company will continue to manufacture the Janitrol aircraft heater, which was a wartime development for military planes. **Robin A. Bell,** who headed wartime sales of the aircraft heaters, has been appointed sales manager of the newly-established Janitrol Aircraft Heater Division of the heating equipment manufacturing company. In addition to directing sales to the established aviation market, Bell will explore possible applications for the aircraft heater with the "whirling flame" in other fields.

R. A. Bell

M. C. Turpin has been appointed assistant secretary of the **American Society of Refrigerating Engineers.** For 15 years he was supervisor of the Electric Appliance Division, Westinghouse. He is a charter member and one-time chairman of the Baltimore-Washington section of the ASRE. Mr. Turpin received his EE degree from Alabama Polytechnic Institute and he did post-graduate work at Cornell.

INSULATE EVERY DUCT

Saves 75% of Bare Duct Heat Loss
•
Thermal Insulating Efficiency of 70%
•
K Factor .27 B. T. U.
•
Frictional Resistance F=0.0001322
•
Deadens Metallic Noises
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Absorbs 70% of Airborne Noises
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Prevents Condensation
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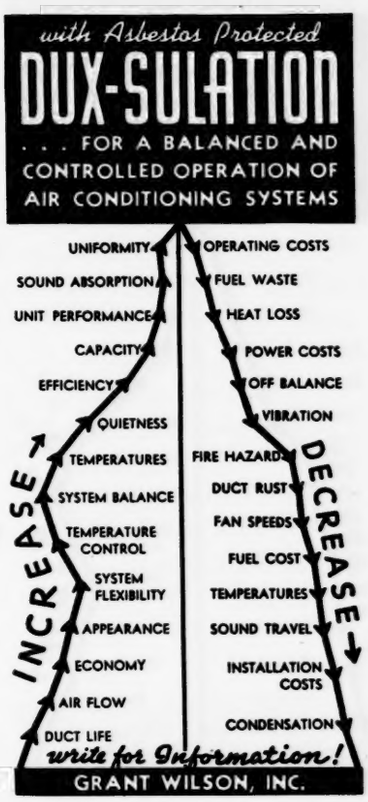
Complete for Easy Installation



DUX-SULATION is the Asbestos Protected Insulation Felt that excels in every operation from cutting to finishing and insulates against heat, cold and sound. It is a proven product designed and developed especially to be the most satisfactory and efficient insulation for Ducts.

DUX-SULATION is approximately ½" thick and is composed of millions of fine flexible fibres fabricated into a Felt of unusual strength. The fineness of fibres and manner in which they are built up gives you the many dead air spaces so necessary for high thermal insulation and sound absorption.

A heavy Asbestos membrane is woven into the Felt body just below the soft surface which gives you the protection of fire-proof Asbestos. The outer or top surface is a heavy woven fabric through which the fine fibres are worked so that the top surface is finished into an attractive sound absorber.

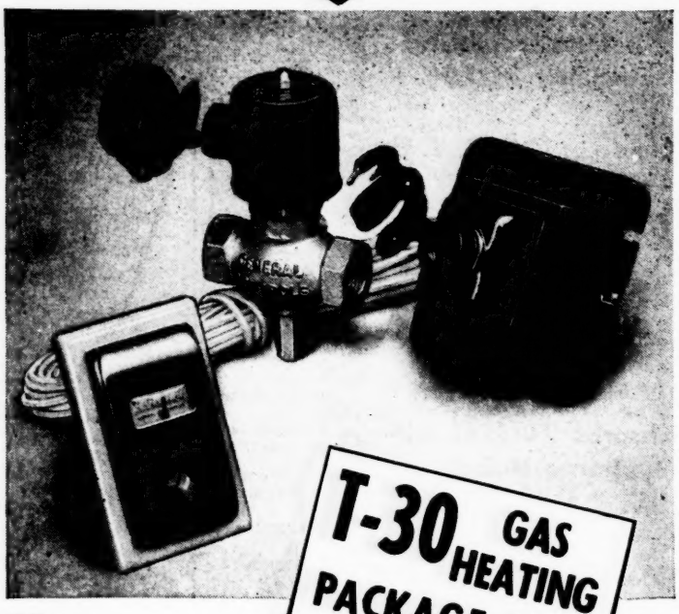
DUX-SULATION can be applied to round pipes, rectangular ducts or irregular surfaces. It bends in any direction, even to very sharp and abrupt angles. It sweeps over the duct work as though it were a part of the sheet metal itself. When the tape is neatly applied to the corners and the joints, you have a very attractive completed job that harmonizes with almost any surrounding.

GRANT WILSON, INC.
141 WEST JACKSON BLVD. AT LA SALLE ST. CHICAGO 4, ILL.
22nd Floor, Board of Trade Bldg. Phone Wabash 8220

Send bulletin No. 407-V containing the full story of DUX-SULATION—the all purpose insulation.

FIRM NAME.....
STREET.....
CITY.....STATE.....
ATTENTION OF.....

Economical
THERMOSTAT SETS



For
NATURAL and MANUFACTURED GAS

Finely engineered, field proved packaged sets for compact inventory and convenient installation. Ideally adaptable to gas-fired boilers, floor furnaces, conversion burners and warm air furnaces.

Set includes type K-3B two-wire gas valve, T-70 Metrotherm, transformer and 30 feet of cable.

ADAPTABLE TO L. P. GASES

100% shut-off is assured by the additional installation of an MR-2 electro magnetic thermovalve with 26-R Series pilot burner.

Write for Catalog 52B and Manual FI-101.

GENERAL CONTROLS
801 ALLEN AVENUE GLENDALE 1, CALIF.

FACTORY BRANCHES: PHILADELPHIA • ATLANTA • BOSTON • CHICAGO • DALLAS
KANSAS CITY • NEW YORK • DENVER • DETROIT • CLEVELAND • PITTSBURGH
HOUSTON • SEATTLE • SAN FRANCISCO • DISTRIBUTORS IN PRINCIPAL CITIES
14—2

John S. Hart has returned to Chicago from his war activities and has resumed his position as Chicago district manager for the **Central Station Steam Co.** of Detroit: In 1925 Mr. Hart graduated from Purdue University with the degree of B. S. in M. E. He has since received an M. E. degree from the same institution.

On May 1st, 1929, Mr. Hart became Chicago district manager for the Central Station Steam Co. and held this position until February 1942 when he took a leave of absence to enter the employment of the Chicago Ordnance District. A few months later he became mechanical and electrical engineer with the U. S. Army Corps of Engineers and was in responsible charge of all mechanical and electrical installations in the construction of the thirty-eight million dollar Gary Armor Plate Plant at Gary, Indiana. Later Mr. Hart became Project Supervising Engineer and was responsible for the satisfactory completion of the entire project. Included was a steam plant with 4—600 H. P. automatic gas or oil fired boilers and a complete distribution system containing about 30,000 feet of mains and services.

From this plant Mr. Hart went in an engineering capacity to a large project in Tennessee, where he remained until his recent return to Chicago.

He is a member of A. S. M. E. and, of course, has been a member of N. D. H. A. for ten years.

Charles H. Morse III has been elected vice-president of **Fairbanks, Morse & Co.**, according to an announcement by Col. Robert H. Morse, president. Mr. Morse will be in charge of research patents, traffic, the company's western pump division, and the Inland Utilities Co., Fairbanks-Morse subsidiary with properties in 41 cities and towns in Colorado, Kansas and New Mexico, Col. Morse said. His headquarters will be in Chicago.

C. H. Morse, III

Immediately after receiving his discharge following two years of service in World War I Mr. Morse entered the company's Three Rivers, Mich., plant as a factory worker. Then followed intensive training in various departments of the company that ranged from factory man up to his present post. He is a son of Col. Robert H. Morse, and a brother of Robert H. Morse, Jr., vice-president and general sales manager. His duties will enable him to play an active part in the production of such Fairbanks, Morse & Co. items as Diesel engines, pumps, motors, scales, Diesel locomotives, and other equipment.

Manning, Maxwell & Moore of Bridgeport, Conn., manufacturers of Ashcroft gauges, Consolidated safety and safety relief valves, Hancock valves and American industrial instruments, announce the following sales personnel changes effective immediately. **Charles L. Harris** is appointed manager of distributor sales. **Newton P. Selover** will succeed Mr. Harris as manager of the mid-western district. **William F. Loos** has been appointed eastern district manager with headquarters in the executive office of the Chrysler Building, New York City. **William H. Bolin** has been appointed mid-eastern district manager with headquarters in Pittsburgh succeeding Mr. Loos.

A. Gordon Wootton, former chief of Refrigeration and Air Conditioning Section, Special Equipment Branch, General Industrial Equipment Division, WPB, has returned to the **Seeger-Sunbeam Corp.,** manufacturers of commercial refrigeration, as manager of the southeastern territory, with headquarters at Atlanta, Georgia.

Controldtemp, distributors of air conditioning, heating, ventilating and refrigeration equipment, has placed **Milton Gershon,** a graduate of Stevens Institute of Technology and a licensed professional engineer, in charge of sales for the State of New Jersey.

Officials of **Joy Mfg. Co.** announced at the company's general offices in Pittsburgh that an agreement has been concluded for the acquisition of **La-Del Conveyor & Mfg. Co.** of New Philadelphia, Ohio, chiefly through an exchange of stock. Operations will continue at the present plant site without interruption, the company name eventually being changed to the La-Del Division of Joy. Products of the two organizations effectively supplement each other. La-Del, a manufacturer of mine ventilating fans and portable mine blowers, also produces a highly regarded line of shaker and other mine conveyors widely used where geological conditions are unfavorable to the installation of Joy's larger and heavier mining equipment, particularly in anthracite mines.

In addition, La-Del manufactures a high pressure axial flow fan of new design, which has applications in dust collecting, air conditioning, refrigeration, forced and induced draft heating, ship ventilation and other industrial uses. Design of this fan was completed just at the outset of the war and now it will be available for the first time to industrial users.

William B. Winslow, vice-president and general manager of **Baker Ice Machine Co.,** has announced the appointment of **Sterling F. Smith** as general sales manager. Mr. Smith will be responsible for all sales of the Baker Co. whose manufacturing facilities and general offices are located in Omaha, Nebraska.

American Engineering Co., Philadelphia, announces the appointment of **R. F. Van Alstyne,** 306 Fairmont Street, Davenport, Iowa, as their representative for the sale of Taylor and Perfect Spread Stokers. His territory includes Des Moines and the Eastern half of Iowa, as well as the Tri-cities.

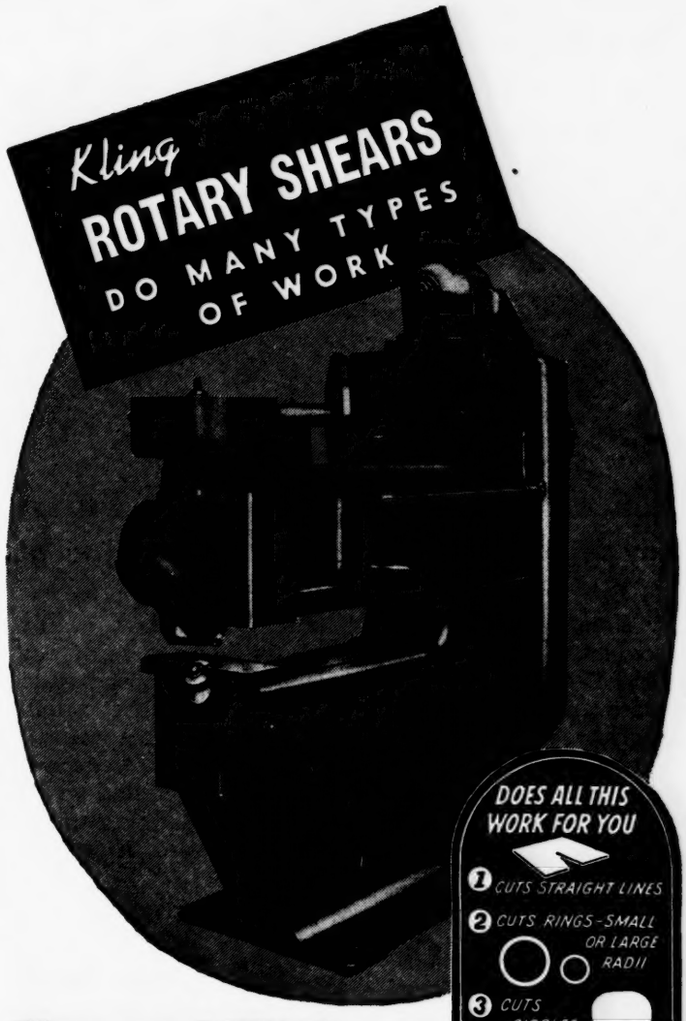
Harold A. Holbrook, field representative for **Anthracite Industries, Inc.,** in the New England territory, has returned to his field duties after three years' service in the Navy. He had been with the anthracite organization since 1937 and prior to that time was engaged in the coal trade publishing field.

Dr. Francis C. Frary, director of research of **Aluminum Co. of America,** has been elected to receive the Perkin Medal in recognition of his outstanding accomplishments in the field of industrial research, it was announced recently by Cyril S. Kimball, Secretary of the American Section of the Society of Chemical Industry.

Funeral services for **Davis S. Boyden, 72,** retired superintendent of the steam service department of the Boston Edison Co., were held last month at Allston, Mass. He died November 26 in St. Petersburg, Fla.

Mr. Boyden was educated at Lowell Institute. He was associated with the Boston Edison Company for 31 years until his retirement in 1939. He was past president of the National District Heating Association and the ASHVE. He was active in the Massachusetts National Guard.

His company regretfully reports the death of **Mr. Arthur J. Johnson,** president of the **Johnson Fan & Blower Corp.,** 1319 W. Lake St., Chicago 7, Ill., manufacturers of heating and ventilating equipment. Twenty-five years ago, Mr. Johnson founded the organization of which he was president. There will be no change in the policy of the corporation and its operations and production will continue without interruption.



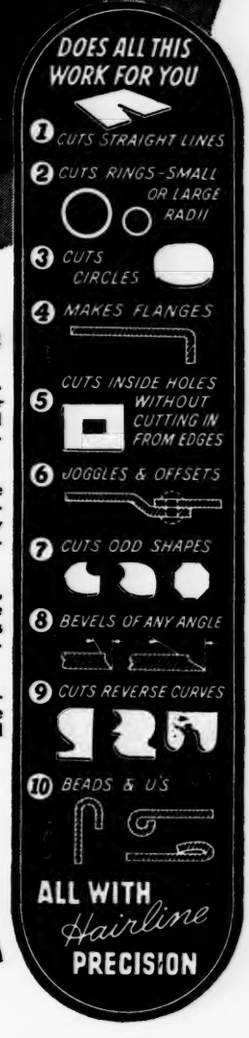
Yes, and With Hairline Precision

Rapid operation . . . Hairline Accuracy . . . the use of Kling Rotary Shears marks the latest development in cutting mild steel, and sheet metal, up to 1-inch with amazing savings in time, labor, and production costs.

For exacting projects (see illustration at the right), no single unit of metal-working equipment does so many different things so cleanly and efficiently as does the Kling Rotary, pictured above.

In metal working plants, automotive, aviation, home appliance, and other industries, where work of this character is being done, — this machine is held in high regard for its versatility and economy of operation.

This great usefulness is the result of half-a-hundred years of engineering experience which prospective buyers, with reason and respect, applaud.


DOES ALL THIS WORK FOR YOU
1 CUTS STRAIGHT LINES
2 CUTS RINGS - SMALL OR LARGE RADII
3 CUTS CIRCLES
4 MAKES FLANGES
5 CUTS INSIDE HOLES WITHOUT CUTTING IN FROM EDGES
6 JOGGLES & OFFSETS
7 CUTS ODD SHAPES
8 BEVELS OF ANY ANGLE
9 CUTS REVERSE CURVES
10 BEADS & U'S
ALL WITH Hairline PRECISION

Send Today for **Bulletin No. 245** which will give you specific facts, and specifications. No obligation involved. Users of heavy equipment of Kling Rotary Shears' class will receive a copy of this Bulletin promptly, on request.

KLING BROS. ***Engineering Works***

1304-HV No. Kostner Ave., Chicago 51, Illinois

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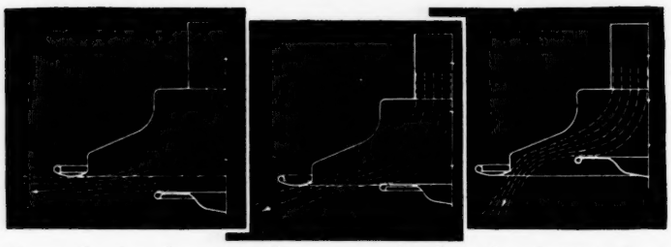
How *adjustable* air diffusers increase the efficiency of supply air diffusion.

Better mixing of room and supply air, more uniform temperatures throughout the occupied zone and noiseless, draftless air diffusion are accomplished with

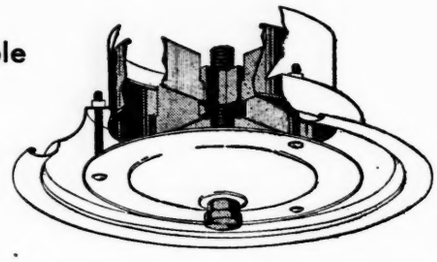
KNO-DRAFT *adjustable* Diffusers



Any desired angle from vertical to horizontal at your fingertip.

By simply turning the air adjustment screws (easily accessible from under the unit) the inner cone of any KNO-DRAFT Diffuser may be raised or lowered to secure any angle of air direction required by ceiling heights, system balancing, and individual or seasonal requirements. Thus the diffuser becomes more effective whether it is used in cooling, heating, ventilating, or combined systems, because it can expel chilled air parallel to the ceiling or eject heated air downward to prevent stratification.

Type K Adjustable Diffuser with Type D Volume Damper.



Pat. and pat. pending

Any desired volume at your fingertip

Every KNO-DRAFT Diffuser can be equipped with a built-in volume damper (easily adjusted by hand-turning knob under diffuser) which varies the outlet aperture uniformly without affecting the outlet velocity or diffusion pattern.

Thus KNO-DRAFT Diffusers can be adjusted quickly and accurately to the angle and volume needed to meet a wide variety of conditions, and as a result, the factors of temperature variation, temperature fluctuation, drafts and noise can be minimized considerably.

The W. B. Connor Engineering Corp. maintains a staff of specialists and district representatives in leading cities to assist you with any air distribution problem.

FREE HANDBOOK

Contains clear sketches, charts, dimension prints and instructive text that simplify the selection and installation of air diffusers.

For your copy write Dept. E-11.

W. B. CONNOR ENGINEERING CORP.

Air Diffusion *Air Purification* *Air Recovery*

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Glendon A. Richards, 78, Grand Rapids plumbing supply manufacturer who formed his first partnership in 1889, died after a long illness at his Bradenton, Fla., home to which he retired four years ago. He was chairman of the board of the **Richards Manufacturing Co.**

Born and educated in Pinckney, Mr. Richards came to Grand Rapids in 1884 and found his first job helping masons build the UBA hospital at Lyon St. and College-av., then learned the tinsmith and sheet metal trade with Foster Stevens & Co. In 1889 he formed a partnership with William S. Barnett and bought a hardware and tin shop on Bridge St. Subsequently he was a partner in the firms of Barnett, Richards & Kuennen; Richards, Kuennen & Co.; Glendon A. Richards Co.; Richards Plumbing & Heating Co., and Richards Manufacturing Co.; and was one of the original founders of the Richards-Wilson Pipe Covering Co., whose name has since been changed to **The Ric-Wil Co.** He also was interested in Richards Storage Co., Grand Rapids Memorial Park, Michigan Brewing Co. and Oakwood Manor. He had served as president of the local and state master plumbers associations.

INDUSTRIAL DEGREE-DAYS
November, 1945

City	55F Base	45F Base
Baltimore, Md.	214	51
Buffalo, N. Y.	448	220
Chicago, Ill.	422	184
Cleveland, Ohio	361	146
Detroit, Mich.	418	189
Indianapolis, Ind.	378	162
New York, N. Y.	256	75
Philadelphia, Pa.	238	68
Pittsburgh, Pa.	330	122
St. Louis, Mo.	316	112

CANADIAN DEGREE-DAYS FOR NOVEMBER, 1945

City	November 1945	November Normal	Cumulative, Sept. 1 to Nov. 30 1945	Cumulative, Sept. 1 to Nov. 30 Normal
Calgary, Alta.	1464	1122	2626	2276
Charlottetown, P. E. I.	825	858	1566	1619
Crescent Valley, B. C.	960	981	2008	2039
Edmonton, Alta.	1626	1215	2853	2379
Fort Williams, Ont.	1164	1143	2375	2219
Grand Prairie, Alta.	1767	1218	3016	2510
Halifax, N. S.	758	789	1425	1477
London, Ont.	798	843	1556	1477
Medicine Hat, Alta.	1320	1104	2295	1972
Moncton, N. B.	903	936	1812	1813
Montreal, P. Q.	1032	948	1799	1689
North Bay, Ont.	1044	1017	2165	1975
Ottawa, Ont.	957	984	1799	1783
Penticton, B. C.	858	813	1678	1553
Porquis Junction, Ont.	1206	1266	2522	2462
Prince George, B. C.	1383	1068	2656	2253
Quebec City, P. Q.	987	1050	1880	1977
Regina, Sask.	1533	1355	2791	2557
St. John, N. B.	840	870	1654	1698
Saskatoon, Sask.	1572	1305	2835	2482
Toronto, Ont.	752	817	1440	1489
Vancouver, B. C.	714	657	1461	1350
Victoria, B. C.	660	462	1318	1172
Windsor, Ont.	735	795	1329	1274
Winnipeg, Man.	1356	1302	2516	2376

*These data are supplied through the courtesy of the Meteorological Division, Air Services Branch, Department of Transport, Canada, with the cooperation of N. W. Etter, Heating Engineer, Enamel & Heating Products Limited, Sackville, N. B.

The Department reports some slight revisions in the figures for October, as published in last month's issue. Corrected figures are: Montreal, P. Q., 580; Penticton, B. C., 539.

COMING EVENTS

JANUARY 28-30, 1946—52nd Annual Meeting of the American Society of Heating and Ventilating Engineers, Hotel Commodore, New York City. C. V. Hutchinson, Secretary, 51 Madison Ave., New York.

FEBRUARY 25-28, 1946—National Association of Home Builders' Exposition, Stevens Hotel, Chicago. Paul S. Van Auken, Convention and Exposition Director for the Association, 111 W. Jackson, Chicago.

FEB. 25-MAR. 2, 1946—20th Exposition of Chemical Industries, Grand Central Palace, New York City. C. F. Roth, manager of the Exposition, Grand Central Palace, New York 17, N. Y.

MARCH 4-7, 1946—Open meeting of Refrigeration Equipment Manufacturers Association with refrigeration jobbers and service engineers, Stevens Hotel, Chicago. Theodore R. Sills, Refrigeration Equipment Manufacturers Association, 43 East Ohio Street, Chicago 11, Ill.

MARCH 20-22, 1946—Chicago Production Show and Conference of the Chicago Technical Societies Council, Stevens Hotel, Chicago. Paul A. Jenkins, Executive Secretary, Chicago Technical Societies Council, 53 W. Jackson Blvd., Chicago 4.

MARCH 28-29, 1946—American Gas Association Conference on Industrial and Commercial Gas, Commodore Perry Hotel, Toledo, Ohio. Ralph S. Wenner, American Gas Association, 420 Lexington Avenue, New York 17, N. Y.

APRIL 23-27, 1946—National Oil Heat Exposition in conjunction with the annual convention of Oil-Heat Institute of America, Commercial Museum, Philadelphia, Pa. C. F. Curtin, secretary of the Institute at 30 Rockefeller Plaza, New York 20.

MAY 7-9, 1946—Annual meeting and exhibition of the National Association of Corrosion Engineers, President Hotel and Municipal Auditorium, Kansas City, Mo. Elton Sterrett, executive secretary, 318 Southern Standard Building, 711 Main Street, Houston 2, Texas.

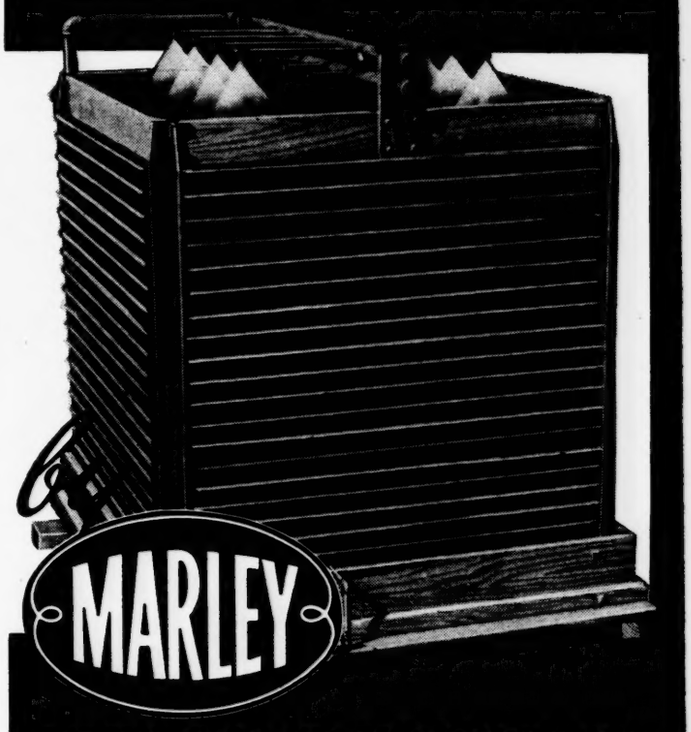
MAY 20-25, 1946—National Marine Exposition, Grand Central Palace, New York City, under the sponsorship of the Propeller Club of the United States. Roger E. Montgomery, general manager, National Marine Expositions, Inc., 17 Battery Place, New York, N. Y.

JUNE 3-6, 1946—Annual Meeting of the National District Heating Association, The Cavalier Hotel, Virginia Beach. John F. Collins, Jr., Secretary, 827 N. Euclid Ave., Pittsburgh 6, Pa.

SEPTEMBER 16-20, 1946—1946 Exhibit and Conference of the Instrument Society of America, to be held in Pittsburgh, Pa. For further details write to Paul G. Exline of the Society at 1117 Wolfendale Street, Pittsburgh 12, Pa.

OCT. 28-NOV. 1, 1946—REMA annual all-industry refrigeration and air conditioning show, Cleveland Public Auditorium, Cleveland, Ohio. Refrigeration Equipment Manufacturers Association, 43 East Ohio Street, Chicago 11, Ill.

COOLING TOWERS
tailored TO FIT YOUR JOB



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If your air conditioning system is of the closed recirculating water type, here is a timely suggestion for preventing slime and lime scale deposits from decreasing equipment performance.

Add Oakite Airefiner No. 52 to the water supply. You'll find that this additive not only combats slime, it also stops lime-scale formations from clogging drains, piping, spray heads and pumps. Free technical data gives complete details . . . describes quick ways to condition system before treating water to assure successful results. Ask us to send you FREE details TODAY.

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